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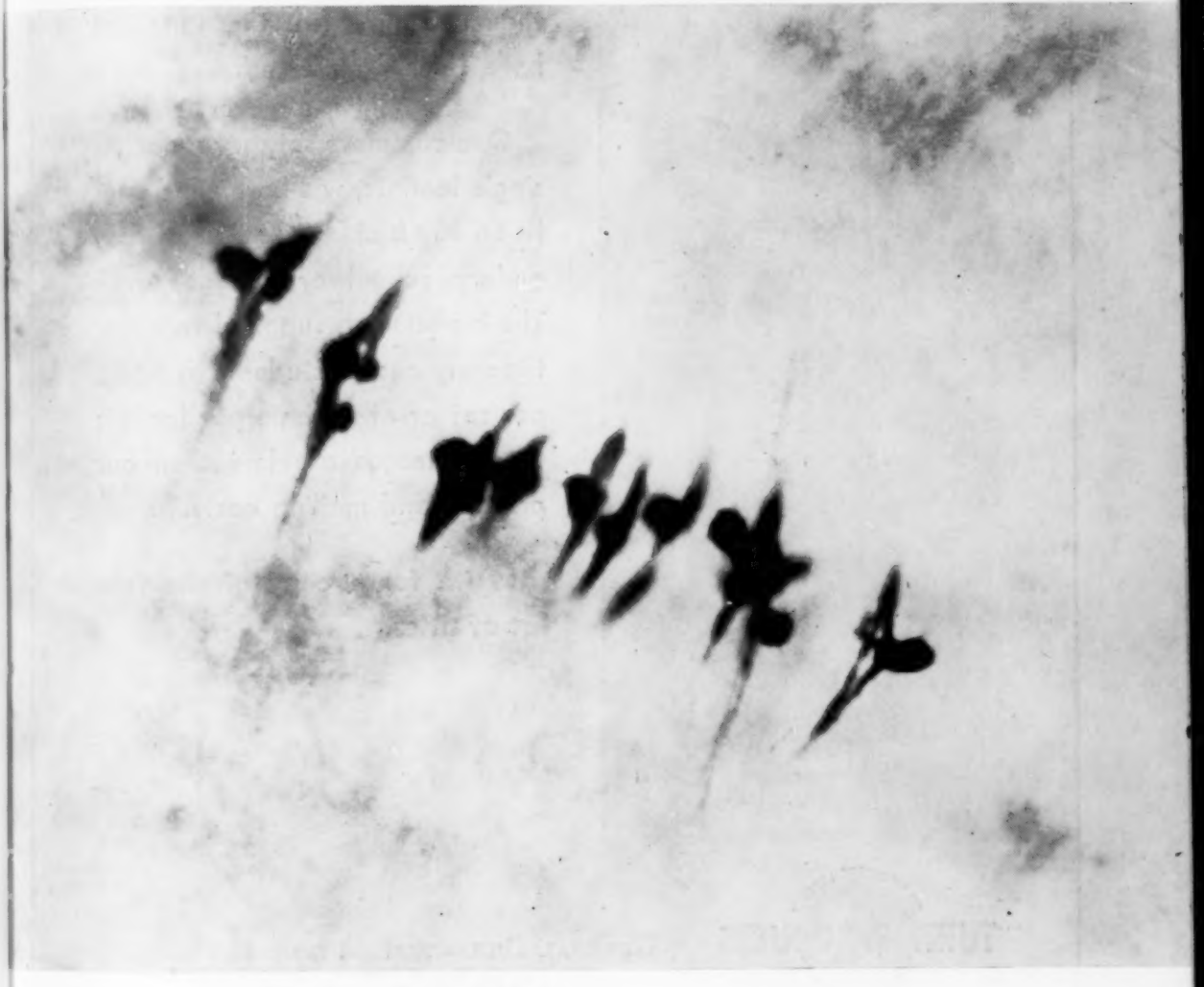

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Cover Picture

Metaphase during meiosis in maize. This splendid photograph was taken by Prof. Marcus Rhoades, chairman of the Department of Botany, and Miss Ellen Dempsey, research associate, Indiana University. Magnification: 2500x.

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We Are Now Adult

On the occasion of the twentieth anniversary luncheon of NABT in Washington last December, I remarked that the adolescence of NABT was ended, and the adult phase of the organization was beginning. In terms of chronology, program, membership, and future dreams this is now becoming quite evident. Indeed, often adulthood comes sooner than some people and some organizations are ready to face it. I believe most sincerely that NABT is now an adult organization and ready to enjoy a brilliant future with its potentialities, with a rapidly increasing membership, and yes, with its obligations. Let me outline some of the problems that now face an adult NABT.

Membership: With the splendid work of the membership chairmen throughout the United States under the efficient and diligent work of the Third Vice-President, Robert Smith, the membership of NABT has grown tremendously in the last few years to a total in excess of 4500. Certainly, too, this increase is also one of the products of the hard work of the Secretary-Treasurer, Paul Webster. Indeed, from the evidence that we have, we believe that we have one of the highest percentages as members of the total number of potential members of any national science teaching organization. This is the tangible result of much time and hard work.

Yet much remains to be done. In contacts with biology teachers in various NSF institutes this summer it was evident that there were many who were not members of NABT and many who had not heard of the organization. It is also true that there are many new biology teachers each year as well as a considerable group of teachers who are teaching biology but not as their main assignment. In other words, there are many potential members of NABT.

As we are told at each Board of Directors meeting, the goal of an increased membership is possible with more work, more money, and more assistants. The problem is clear, and the solution is clear.

AIBS: In the past two years the American Institute of Biological Sciences of which NABT is a member organization has had a great and vigorous interest in the business of education in the biological sciences. As the only national organization which joins together the research biologist, the college biology teacher, and the secondary school biology teacher, and one which has a Washington office and staff, it was natural that foundations and agencies interested in the improvement of biology teaching would turn to AIBS for assistance. NABT leadership has been called in on these projects.

One of these major projects is the Film Series and another, the Biological Sciences Curriculum Study. When the rosters of the Steering Committees and sub-committees of both of these are examined many NABT names will be evident. The four-man Executive Committee of the BSCS includes the President of NABT. Although it is hoped that more NABT names will be included in the leadership of these activities, especially when the project specifically involves secondary school biology, it is certain that NABT has been consulted closely when committee rosters were being prepared. There is every indication that many more such assignments are to be made, and the membership of NABT in AIBS will be a significant factor in locating the best personnel.

Other projects concerning education sponsored by AIBS are in operation or are being planned. One such example is the Secondary School Lecturership Program announced elsewhere in this issue. These are real contributions to the improvement of biology education, and NABT will play a significant role in them. This is possible as long as NABT remains the secondary school arm of AIBS.

The Governing Board of AIBS decided in 1958 that dues for member organizations must be increased. Accordingly, the dues of $1.00 per member in each member organization was continued, but the maximum of $1,000.00 per organization was to be abolished. While we opposed this because we are one of the larger organizations within AIBS, and our assessment would be increased four-fold, we also disliked the penalty placed on large size and the premium placed on small organizations. Certainly, fractionating organizations any more is most undesirable. Also, the average personal income of NABT members is probably lower than that of the other societies.

But the financial problems of AIBS were real, and its development in the future is predicated on the solution of these problems.

The AIBS Bulletin is mailed to all NABT members. This service is to be expanded to more issues per year. Other services and projects are to be initiated and expanded. We must use AIBS as a service organization to biology teachers, and this phase of their operation is to be improved and expanded. In fact, we must consider the AIBS office as our Washington office. Prof. Dorothy Matala, our AIBS representative, has been doing a splendid job and has earned the praise of the AIBS Staff and other Governing Board members.

Secondary school biology teachers cannot afford to ignore the many national movements which affect secondary school biology instruction. We must retain our voice in them if they are to be meaningful and useful to the secondary schools. The price of our continued membership in AIBS has been raised. The problem is clear, and the solution is clear.

Administrative Reorganization: One of our large problems is the necessity of involving more of our members in the work of NABT. Passive journal readers must become active NABT members. One of the difficult jobs of your officers is to name the outstanding biology teachers throughout the country, their background, their interests, and their abilities. Few secondary school biology teachers publish papers in professional journals, and thus it becomes difficult to locate the "good" teachers, whereas on the college level this problem is lessened because publications of outstanding people are easy to assess. Appointments to AIBS, NSF, and many other project committees and panels are being made on your officer recommendations, and we need a more realistic and up-to-date list.

NABT needs reorganization to include more members in the administrative family. While this seems simple, there are many problems. Accordingly, we should like to propose Regional Directors, elected, and who know intimately the real educational leaders in their region. These Directors will have many responsibilities, but one will be to initiate some local meetings and activities. Again, this will require a budget for their expenses and a meeting of the Directors. The problem is clear, and the solution is clear.

Journal Expansion: The work of the late Professor Armacost has done much to make ABT a valuable journal for biology teachers. Yet problems have risen. It is no surprise that printing costs have increased. Yet beyond this, we definitely wish to expand the ABT and to develop special issues and articles. We have many plans to accomplish this. Our back log of good articles is big. We wish to pinpoint some specific problems in biology teaching and have the best people available write about them. This takes time and more real work on the editorial staff. Yet, a budget is still the other large factor. The problem is clear, and the solution is clear.

Future Projects: Six significant and extensive project proposals for NABT are now being prepared. While this is not the time, nor is there the room here to describe these in detail, I can assure you that they are exciting, extensive, and significant. I am very hopeful that they will become realities.

Some very devoted and knowledgeable NABT members are now formulating these at some personal sacrifice. It is no secret that most large universities employ full-time personnel to develop this type of thing. It is a very time-consuming and expensive process, involving people who have a special ability in this line. We must push this development hard, and time, finances, and interested personnel have been lacking. We now cannot *afford* to ignore our obligation in this development.

The problem is clear, and the solution is clear.

Administrative Budget: A wise man has told us that we are an "in-between" organization. We are too large to depend on "labors of love." We are too small to afford the paid staff devoted full-time to all the responsibilities we have.

I cannot tell you in sufficient detail the vast amount of work and time—much done at personal financial sacrifice—that many of your officers have devoted to NABT. The office of President has many demands, and the duties of the Vice-Presidents, while not as extensive, are nevertheless enough that only real servants of NABT are ready to discharge them in the manner to which we have been accustomed. Probably the two hardest working officers are the Secretary-Treasurer, Mr. Paul Webster, and the Managing Editor, Mrs. Muriel Beuschlein. Yet we cannot go on indefinitely

depending on such people. Mr. Webster, for instance, who has served in this post longer than other previous Secretary-Treasurer, finds it necessary to resign.

A paid executive secretary will probably require a budget of at least $15,000.00, according to best advice we can get. Part-time service in this spot is our alternative. Yet persons willing to serve under these conditions with a "know-how" in NABT and the very busy biology education field are rare—and perhaps extinct.

What we must have is the continued devoted services of the administrative officers of NABT, but in addition, we must have substantial honoraria and expense money for the work, and perhaps a part-time paid person as Secretary-Treasurer. This is another problem which is clear, and the solution is clear.

Liaison Committee: The Board of Directors mandated the President at its meeting last December to appoint a Liaison Committee to project NABT into the future, and to come up with positive recommendations. This Committee held an intensive two-day session in Chicago this July. While several persons invited to serve on the Committee did not find it possible to attend, the following people did attend and constitute now the Liaison Committee: Muriel Beuschlein, Managing Editor; John Breukelman, Past President; Phillip Fordyce; Paul Klinge, President; Dorothy Matala, AIBS representative; Richard Weaver, Past President; Howard Weaver, President-Elect; and Paul Webster, Secretary-Treasurer. The decisions of this group were unanimous and arrived at after long and hard discussion. Again, they are busy people who sacrificed for the good of NABT.

While their complete report will be presented to the Board of Directors this December, some of their recommendations are already in effect, others must be presented to the Board for approval, and a few were authorized because most of the members of the Executive Committee were represented on the Committee.

The tentative budget proposed made provisions for payment of increased AIBS dues, increased honoraria and expense money for officers, expanded journal, more membership services, expanded budget for membership work, expense money for Regional Directors, and some money to be saved for an executive-secretary fund. All this was predicated on an increase of membership dues to $6.00, some revenue from project grants, and a membership number that will not drop significantly, but in fact expand.

The Liaison Committee grappled hard with the facts of our adult existence. It is confident that it has developed its recommendations and budget with a practical yet hopeful attitude.

Our Responsibility: Accordingly, our duty as members of an adult organization now is quite clear if these problems are faced realistically. We must be more than a paper organization. We must face a brilliant future with many hopes, dreams—and *concrete* plans. While it is not the single answer to these problems of NABT adulthood, there is a common denominator in the solutions proposed—that is, additional income. Dues of $6.00 will be the *big* step.

With the continued loyalty of the present NABT membership, the continued devotion of its officers to their duties and obligations, and a steadily increasing membership, the twenty-fifth and the thirtieth Anniversary celebrations will look with pride on the decision of 1959 to put NABT on an adult basis so that a brilliant and useful future was assured rather than left in a cloud of doubt.

PAUL KLINGE, *President*

More on Cholesterol

Cholesterol, often blamed for diseases of the heart and arteries, might help prevent the conditions that bring on heart attacks if it were present in abnormally large amounts, a University of Nebraska researcher declared. In laboratory test tube studies, the amount of cholesterol that might be found in the blood after a heavy high-fat meal promoted clot formation, but higher concentrations retarded or prevented this dangerous condition, reported Dr. Herbert L. Davis, associate research professor in biochemistry and surgery in the university's College of Medicine. Such high quantities of this fatty substance do not accumulate in normal blood, but persons suffering from diabetes have been known to have exceptionally high levels of blood cholesterol. Some diabetics may suffer hemorrhages because of the long blood clotting times induced by high blood cholesterol, he added.

A Study of College Introductory Biology Courses*

JULIAN L. SOLINGER
Simmons College, Boston, Mass.

PART I

I. *The Plan of the Survey*

Over the last few years it has become increasingly evident that there is a great interest in the reevaluation of the offerings in the introductory courses in biology. In a recent text, F. Champion Ward (1) stated, "What is needed now is communication among those who are engaged in general education in the nation." This statement applying to general education might also be applied to the present status of biology teaching. It was thought that in the teaching of biology the great need for exchange of information and ideas was universally evident. As there had been no direct study of a large number of courses at the college level, it was felt that useful information might be obtained by such a survey.

During 1951-1952 visits were made to fifty colleges, and information was obtained about 131 courses offered as an introduction to Biology.

Table 2 indicates the length and types of courses. The term Integrated Biology is used to describe the usual general introductory biology course. The term General Biology-General Education indicates any course in beginning biology which was described either by the instructor or the college catalog as fulfilling the purposes of General Education. The term General Biology-Zoology and Botany is used to describe those courses composed of one semester of Zoology and one of Botany.

In a directed interview with the instructor of each course, information was gathered as to objectives, course description, course content, procedures and methods, and the general laboratory equipment available. In addition, other information was also recorded. Lecture, laboratory, and recitation sections were visited wherever possible.

II. *Objectives of Biology Courses*

In a publication by the Botanical Society of America (2), it is stated that, ". . . there is a great diversity in objectives, procedure, content and testing in elementary college botany courses—such diversity is not only inescapable, but is desirable, since the character of institutions, students, and teachers varies so widely. Standardization—would tend to inhibit the continuation of experimental change and improvement." In keeping with this, it is not the purpose of this work to impose any standardization, but to indicate practices in use. The findings might then serve to stimulate reinspection or reevaluation of our courses.

In certain outstanding courses a careful formulation of objectives, followed by a conscientious attempt to fulfill them, appeared to be the key to their success. The consensus was that the main objectives of a course should be broad and should place emphasis upon the development of the student's ability to reason and to understand the discipline of science. The development of ability to form sound judgments based upon the facts at hand was a characteristic statement of objectives for some excellent courses. Following are statements of objectives made by some of the instructors interviewed.

Homer C. Sampson (3) poses such thought-provoking questions as: "Have we been influenced too much by tradition in the organization and order of present content material? What point of view, or philosophy, of interpreting biological phenomena—is in best accord with the scientific method and the discoveries of science?" He states that there are "two essential groups of objectives:

> first, the acquisition of information; and
> second, the intelligent use of information in effective thinking and interpretation, and in developing certain habits, skills, abilities, attitudes, and points of view."

He lists main objectives as those which "if

*Written while on a fellowship program sponsored by the Fund For The Advancement of Education. Part of the material was gathered under a grant from the National Science Foundation and the Survey of Physiological Sciences. A summary of this study was presented at the NABT sessions of the AAAS in Washington, 1958. Grateful acknowledgement is due to the instructors at the many institutions which were visited. This survey could not have been completed without their cooperation.

TABLE 1

Institutions Visited		Location of Institution		Number of Students	
Men's Colleges	8	East	26	Under 500	3
Women's Colleges	8	Midwest	15	500 – 1,000	10
Co-educational	34	West	9	1,000 – 2,500	13
				2,500 – 5,000	7
				5,000 – 10,000	4
				Over 10,000	13

attained, ought to carry over into the life relationships of the student beyond the classroom." These are:

"1. Perspectives, such as recognition and appreciation of causality in the biological world;
2. Attitudes, habits, skills, abilities, and standards; such as—arriving at inferences or conclusions warranted by a specific set of data, and
3. Information."

At another institution the catalog states (4) "...the objectives are to convey understanding of some of the larger problems and achievements of biological science, and of their relationship to other fields of knowledge and experience; understanding of living organisms generally, of man as a biological entity, and of his place in nature."

Chester A. Lawson (5) indicated that in the course in basic biological science with which he is associated, their general objective is, "To motivate and guide the student in the development of an active interest in his position in the biological world." In order to accomplish this, the student should acquire:

"1. A knowledge and understanding of the individual organism
2. A knowledge and understanding of cooperative and competitive interrelationships among plants and animals
3. Skills and abilities in observation and organization of scientific facts—in the techniques of experimentation—application of the results of the experimentation to the solution of everyday problems.
4. Attitudes and appreciations which lead to intellectual curiosity; clear thought processes relative to biological facts: and understanding of present and possible future achievements of science; recognition of, and willingness to be

TABLE 2

Length and Type of Course

Types	Year	¾	½	Sem.	Trimest.	¼	7 weeks	Total
General Biology-Integrated	15			2	1		1	19
General Biology-General Education	12	3	1	9				25
General Biology-Zoology and Botany	5							5
Zoology	13		2	15	1	1		32
Botany	7		1	17	2	2		29
Physiology	3			3	1	1		8
Natural History				5				5
Genetics				2		1		3
Bacteriology				2				2
Ornithology				2				2
Biochemistry				1				1
Totals	54	3	4	58	5	5	1	131

guided by, competent scientific authority; and perception of aesthetic values in nature."

The objectives indicate a great reliance on formal application of the scientific method. This was observed in both lecture and laboratory sessions.

Loren C. Petry (6) believes the objectives may be phrased by stating that the study of biology should help the student answer the following three questions:

"1. How is living matter organized and how does it operate?
2. What forms does living matter take and how does it get that way?
3. How are living organisms distributed over the earth and how do they maintain themselves there?"

H. Bentley Glass (7) gave the following objectives of his course:

"1. The use of biological material in giving the student an appreciation of the nature of scientific investigation and scientific evidence.
2. An understanding of the manifold importance of science in all aspects of modern life."

Thomas S. Hall (8) has listed the objectives of the basic biological science course as follows:

"I. Intellectual objectives:
1. Acquisition by the student of considerable informational competence as regards biological principles, facts, and methods.
2. Increased ability to evaluate (and give the student the habit of evaluating) written and oral argumentative exposition in terms of its implicit assumptions and internal logical structure.
3. Increased habit of, and ability in, examining the products of his own reasoning in terms of the two variables cited in 2.

II. Aesthetic objective:
Increased ability and desire of the student to obtain enjoyment from his experience with certain people, things, and ideas.

III. Philosophical objective:
An increased desire of the student to achieve a clarification of his value system, and those of other persons, and an understanding of the relevance of certain biological facts and principles toward such achievement."

Many instructors indicated that one of their objectives was to show the non-scientist how the scientist looks at things.

III. *Types of Courses and Their Place in the College Curriculum*

A. Science requirements

At forty-five of the fifty colleges at least one course in science was required, and in one instance the required science was biology. Where more than one science was required, twelve colleges required that biology be one of those taken.

In an interesting experiment which is in progress at one institution (9) all students who elect biology have a common first semester. The material presented during the first semester is broad in scope and serves as an introduction to biology. For the second semester the student may choose either a course in Botany, Zoology, or Human Biology. This last course is for the so-called "terminal" student. Credit is also given to the few students who elect only the first semester.

B. Types of courses offered

The courses offered, which serve as an introduction to biology, are indicated in Table 2. The conventional "survey" course is no longer popular and was seen in very few institutions. In fact, the word "survey" as a description of a course was used at only one institution.

The twenty-five general education type of courses in biology were seen at twenty-two colleges. There was no uniformity in these courses. They varied from the modified case-history type of presentation, to a course in which practice in the use of the scientific method was the core. To these were added a number of other variations which included conventional elementary courses, relabeled.

Nineteen courses in integrated general biology (a broad treatment of biology without the strict division into zoology and botany) were offered at sixteen institutions. These also varied in their philosophy and content from conventional courses to courses of exceptional depth and to others with more superficial treatment. The emphasis in these courses varied, as in the general education courses, from broad treatment of principles to complete con-

centration on detail. The consideration of man as the culmination of animal development was sometimes found as a core subject. Some rather refreshing courses gave a greater emphasis to natural history and from this derived certain values that have disappeared from much of modern biology.

Only five colleges offered a year biology course made up of one semester of botany and one semester in zoology.

There were thirty-two zoology courses offered at twenty-five colleges and twenty-nine botany courses offered at twenty-four colleges. In many cases, a zoology course is taken by the pre-medical and other pre-professional students with similar objectives. In an attempt to meet the requirements of professional schools and to provide capable and well-trained students these courses may be extremely conservative, detailed, and difficult. When there was a large proportion of pre-medical students registered in zoology courses, the course work was often very rigorous.

It was surprising to find eight colleges offering courses in physiology as a first course in biology. The majority of the courses appeared to serve as time-saving expedients for students in special categories, such as those majoring in physical education. The treatment was often superficial, and it was evident that considerable time had to be spent teaching general biology within the framework of a physiology course. As so few colleges offered as an introduction to biology such courses as natural history, genetics, ornithology, bacteriology, and biochemistry, they will not be considered in this report.

There has been much controversy regarding over-specialization in beginning science courses. Specially designed courses in beginning biology are given for pre-medical students, for physical education students, for liberal arts students, and for students with other special objectives. The pedagogical soundness of any type of over-specialization in a beginning course may be questioned. However, the circumstances at an institution may be such that this is the wisest plan. One instructor said, "If we have a certain number of basic concepts and principles in Biological Science why shouldn't we present them to all students as part of their general education?"

Furthermore, in some instances, beginning courses are given which do not prepare the student for additional courses in the subject and therefore are terminal. Although most instructors feel that laboratory work is an important educational experience in the beginning biology course, in a few cases, the terminal courses may have no laboratory sessions or may have a demonstration section instead of laboratory work. Table 3 indicates these facts and the distribution of terminal courses.

A number of biologists have criticized the special terminal course in the beginning biology. The consensus was that if a course were adequate for one type of student it should also be adequate for other students. This may be an oversimplification of the problem as the well-motivated student may be ready to assume responsibilities imposed by a more rigorous course and may make excellent progress with little supervision. On the other hand, the less motivated student who needs more help and encouragement may require a different type of course.

IV. *Methods*:

A. Type of presentation

Although the use of lectures has been criticized and has been discontinued in a few institutions, the lecture method is in use at

TABLE 3

Distribution of Terminal Courses

No.* of colleges offering course	Type of Course	No. of colleges in which course is terminal	No lab nor demonstration	No lab but demonstration
16	General Biol. Integ.	2	1	1
25	General Biol. Gen. Edu.	8	1	1
25	Zoology	3	0	1
24	Botany	2	0	0

most of the colleges. The majority of instructors felt that this was as effective as any teaching practice. Administrative approval of this type of instruction is quite obviously encouraged by the economy of instructors' effort and of instructional expense.

A few instructors have utilized various devices to make their lectures more effective. Some instructors provide lecture outlines either before or after lectures. One instructor provides students with an expanded and illustrated lecture outline in printed form; this is annotated by the students during the lecture. Another instructor furnishes outline copies of all projected pictures, while still another, after the lecture is over, posts copies of all drawings used in the lecture. It would seem that although the lecture method is effective, a moderate number of instructors feel that there are limitations for which they must compensate. When difficult material is being considered, one instructor provides the students with detailed notes of his lectures. Thus he makes it possible for the students to follow the reasoning with less distraction.

Some instructors believe that an outline of the course is useful to the student. Various reasons were given for this practice among which were: that the outline indicated the broad purpose of the course, that it indicated the assignments in a clear fashion and might promote good study habits, or that it kept the instructors from wandering too far afield. Students were given outlines of the material to be covered in 58 of 107 courses.

In a moderate number of courses "guest" lecturers are routine. In some cases, extreme care is taken to brief the "guest" lecturer so that his topic will be integrated with the course material. In some cases an outline of the course will be provided the "guest" lecturer, and the material to be covered will be described in detail. The instructors in charge of some courses make careful notes during such a lecture in order to have the material available for testing the students.

There are certain advantages which may be gained by other types of presentation although most administrators appear reluctant to experiment. The inclusion of a so-called discussion, recitation, or tutorial session is infrequent. Of 130 courses, in only nine were discussion periods an integral part of the course. Many instructors expressed themselves strongly as favoring a "give and take" session with the students in the classroom. A small number of intsructors stated that they attempted to stimulate student discussion in the laboratory. However, it was agreed that in many instances student discussion did not occur regularly because of inadequate time or the lack of adequate instructors in the laboratory.

In a few courses discussion or recitation was directed with distinction. It was demonstrated that this type of instruction was extremely effective when led by a competently trained individual. In the ideal situation students showed an admirable ability to grasp difficult material and to reason in a most adequate manner. An excellent treatment of the methods of this technique is available (10) (11).

The so-called discovery-discussion type of presentation is another method of instruction which merits consideration. Essentially, this involves a mutual investigation of problems and material with both instructor and student participating. The instructor may ask questions which involve current material or that which has been presented and developed previously. The students are led to make inferences and draw conclusions. Usually a very extensive workbook is provided for use during class sessions. The object is to help the students to develop concepts in the classroom. Most of the instructors using this tecnhique expect the the student to come to class with no "preknowledge." This type of presentation is usually planned for a series of five one-hour meetings weekly and is obviously an extremely arduous type of instruction. However, those who have used this method are, in many cases, extremely enthusiastic as to its effectiveness. The highly trained personnel needed and the cost of organization in both time and money appear to preclude its adoption in most institutions. A moderate number of instructors use this method in modified form.

There are a few institutions where students are required to read "classical" contributions to biological science. Subsequently, this material is discussed, and the students are led to analyze the material for its importance. In some courses, selection is confined to limited areas with an attempt to achieve greater knowledge in those areas. In other institutions the readings are chosen more widely.

At one institution the instructors utilize

the so-called demonstration room in connection with each laboratory session. Additional pertinent material is placed here and part of the laboratory session is spent in a tour of this room. An interesting and exceedingly useful variation of this device was seen at another university, where there is available not only enriching biological material, but also books, charts, and lantern slides. The material on exhibition also includes that which was used in the laboratory in recent weeks. The room is open for student use when the laboratory is not in session and thus becomes a real workshop. The instructors in the course make use of this room for informal conferences with the students. This is a most significant innovation in techniques.

B. Administration of course

The course in beginning biology is of great importance to a department of biology. The largest enrollment of students in the department is generally found here, most of the students receive their impression of the biology department here, and last but not least, it is here that students may or may not be attracted to further work in the department. However, in institutions with large numbers of premedical students or graduate students, the biology or zoology departments often show a distressing lack of concern about the beginning courses.

Table 4 indicates the types of administration found in one-hundred ten courses in integrated biology, general education biology, zoology, and botany courses.

It can be seen that the usual type of administration (72 of the 110) is that of a designated person given full responsibility for administering the course. In some cases, the course may have been organized originally with the help and advice of the department, but in most cases the course is developed by the administrator with or without the help of his colleagues in the course.

The heads of the departments administered twenty-six courses. In smaller institutions this was not unsuccessful. Two very successful courses, if considered from the point of view of production of biologists and successful applicants to medical school, were so administered. However, in these instances the course was the primary interest of the head of the department. As a rule, when a department head has charge of a beginning course, there is little critical appraisal of the work, there is delegation of authority and loss of contact with the students particularly in the laboratory.

Participation of the whole department, or a committee of the department, was seen in nine courses. This generally resulted in a well thought out plan by the original group of instructors and an integrated series of lectures. However, with a series of lecturers the continuity may be interrupted and the responsibility for the details of the course, the development of new procedures, and the supervision of the students may be much less effective as no one is at all times directly responsible for co-ordination. The effectiveness of the original plan was sometimes lost when new instructors replaced members of the original staff.

Administration of the course as autonomous sections was seen in only three institutions.

TABLE 4

Administration of Courses in Biology, Zoology, and Botany

Type of Course	Administration by					
	Department Head	Designated Head	The Department	Department Committee Formal	Department Committee Informal	Independ. Sections
Gen. Biol. Integrated	8	7		1	2	1
General Education-Biol.	4	18	1		1	1
Zoology-Botany	1	3			1	
Zoology	6	24	1		1	
Botany	7	20			1	1
Totals	26	72	2	1	6	3–110

Although this gives independence to each instructor, which is good, it often results in great variation in presentation, both as to depth and breadth. Student dissatisfaction occurs when comparison is made of the procedures in the various sections. Although this procedure might be advantageous with two instructors, the disadvantages multiply as the number of instructors involved is increased.

At one institution (12) four people are concerned with the beginning course. They confer as to the details, objectives, and general plan of the course. Each instructor carries his divisions for two semesters, beginning at either the fall or spring semester. Then he does not teach the course for two semesters. Thus two instructors are always free from the course while two are teaching. It was thought by those concerned that this plan alleviated the pressure which accompanies any beginning course with large enrollment. It also was thought that it gave a freshness to the presentation and improved the course.

C. Organization of the course

Most of the courses had a conventional lecture and laboratory organization. In one course laboratory was required for only one semester, and in the other semester consideration was given to topics that do not lend themselves to laboratory presentation. Garrett Hardin (13) stated that, "the danger in having laboratory work is that one may decide the course content on the basis of its suitability to laboratory work." He believes that the plan just indicated gives greater freedom in choice of material.

In seven courses where there were no laboratory meetings, demonstration-discussion sessions were held. One college in which the conference system is used schedules no formal lecture sections.

The "discovery-discussion" method was found in four courses.

The number of hours of class work required per school year varied greatly. For the forty-eight year-courses in which lecture and laboratory classes were held, the maximum class-hours were 270 and the minimum class-hours 112. The ranges of distribution were as follows: from 101 to 130 hours, four courses; from 131 to 160 hours, fourteen courses; from 161 to 190 hours, twelve courses; from 191 to 220 hours, twelve courses; from 221 to 250 hours, three courses; and from 251 to 280 hours, three courses. The same wide variation in total class hours was found in courses which were scheduled for a semester, a trimester, three-quarters, and two-quarters. The number of class meetings per week also varied widely. In ninety-seven courses (year, semester, and other lengths) four had 1 class hour or less per week of lecture, forty-six had 2 class hours per week of lecture, forty-four had 3 class hours of lecture, and three had 4 class hours of lecture. Length of time required for laboratory work also varied widely.

In a few colleges where there were large enrollments in the beginning course, the instructors limited the size of lecture sections. However, in general, the limiting factor was the size of the available lecture halls. The number of students in the discussion or laboratory sections varied from 10 to 42 students; most instructors thought that 20 students was optimum.

D. Coordination between administrator and staff.

The variation in the amount of time spent in planning the weekly procedure was surprising. In some cases the teaching of the laboratory and recitation sections was assigned, with little supervision, to an inexperienced graduate student. However, in the strongly organized, well planned, and coordinated courses there were regular meetings to plan the work, to point out pitfalls, to review weak points of past work, and to go over the mass of details that are associated with any laboratory course. In two institutions, during the weekly conference, the graduate assistants actually performed the experiments and were questioned by the instructor in charge.

The inadequacies of the teaching assistants' preparation were discussed very frankly by a great many instructors. The pressure of graduate work and other duties may prevent the assistant from giving adequate time to prepare for the current work in the laboratory. Also, the graduate student's false confidence as to the extent of his knowledge often results in poor teaching. In addition, unless restraint is imposed upon the teaching assistant, extraneous material with which he is familiar may be introduced. At one university in which a notable course in biology is taught, the appreciation of the need for adequate planning and conference was impressively demonstrated. Here a staff of mature instructors found it

useful and profitable to spend considerable time each week in a discussion of the work to be done. This situation was not unique here but was found at many institutions. Requiring attendance of the staff at lecture was also common practice. Most of the administrators who had discussion or recitation sections in their courses felt that instructor attendance at lecture was absolutely necessary.

In those beginning biology courses in which there was a permanent staff associated for some length of time, much greater interest in the development of the course was evident. A more experienced staff can experiment and then evaluate results in view of past experience in the course.

E. Teaching load

For all the colleges except one, the average teaching load per semester was ascertained. One college was omitted in Table 5 as the conference system in use there precluded the determination of a comparable figure. In

TABLE 5

Teaching Load in Hours and Courses Per Semester in Seventy Departments in Forty-nine Institutions

Maximum Load In Teaching Hours In Each Dept.	Maximum Load in Courses in Each Department							Number of Dept's Having Each Hourly Teaching Load
	1	1.5	2	2.5	3	3.5	4	
3	1							1
4	1							1
5								0
6	1		2					3
7								0
8		1	1					2
9	2	4	2		1			9
10	2							2
11								0
12	5	4	7	2	2			20
13					1			1
14			3		1			4
15			2		1			3
16		1	4		2			7
17					1			1
18			3		4			7
19								0
20					2		1	3
21					1		1	2
22				1	1			2
23								0
24					1			1
25								0
26							1	1
Total – No. of Dept's Having Each Course Load	12	10	24	3	18	0	3	

eleven colleges the teaching loads were different in the Botany and Zoology Departments. In computing the teaching load, only the actual hours of formal instruction in class, recitation, or laboratory were computed. The other assignments an instructor might assume, such as the responsibility for graduate students, administrative work, or research could not be ascertained with any accuracy for comparison. Thus, Table 5 gives only the official teaching load of the instructor.

A great variation in teaching loads is apparent in Table 5. The mid-point for the teaching load hours is 12, and the mid-point for course load, 2 courses. It is obvious that the greater teaching load tends to stifle creative work. The most interesting experiments in modern education methods invariably were at those institutions where the instructor had greater time and freedom for the formulation of new ideas and educational experimentation.

However, the reverse was definitely not true; in that, less teaching load did not guarantee greater creative work in teaching, as the free time might be spent in a variety of activities. Generally, it was found that the instructors with the greatest teaching loads had less assistance in preparation for, and work in, the laboratory. Thus, the heavier loads were often disproportionately greater than indicated.

The excessive teaching load in a number of institutions is a serious matter as both the individual and the quality of his teaching are affected adversely. When such a situation exists, the effect upon the students is obvious.

A rather serious situation occurs at institutions where the instructor's teaching load is computed on the basis of units of credit given for the courses which he teaches. When the laboratory hours are computed as equal to either 1/3 or 1/2 as much credit as a lecture hour, the instructors have very heavy teaching loads as compared to their colleagues non-scientific subjects.

TABLE 6

Numbers of Courses which Include Field Trips

Number of Courses	Type of Course	Including Field Trips	Including Museum Trips Only
19	Integrated Biol.	6	2
25	Gen. Ed. Biol.	11	4
32	Zoology	9	1
5	Botany-Zoology	3	0
29	Botany	22	0
110		51	7

F. Attention to the individual student

Unusually complete records of information regarding the students were seen at some institutions. At one college the department keeps a cumulative record in which is recorded the grades, personal information about the student, and many details concerning the student's progress. This procedure forces the instructor to learn more about the students.

In another large course a detailed "Rating Sheet" is used. Several times during the term, the individual instructors are required to supply ratings for all their students. It was thought that this technique promoted greater attention to the students by the instructors.

Formal careful rating of the student for anything more than the grades earned was not a common practice. It is possible that more adequate records might mitigate some of the inequities that occur when instructors are called upon by their students to provide information for application to graduate school.

G. Visual Aids

Most institutions had as much visual aid material as the instructor wished. In only a few institutions was projection inconvenient or impossible because of lack of proper rooms or equipment.

Two institutions were outstanding in the assistance rendered the instructor in obtaining and servicing the use of visual aid material. At these institutions a separate department had the responsibility for providing and showing material requested.

There was no unanimity of opinion as to the value of slides and films. Some instructors felt that films were of trivial value for instruction. Others felt that they had great value. Some instructors thought films should be used to introduce subject matter; others thought their chief value was in reviewing or adding to familiar material.

A very interesting variation from the usual method of showing films was indicated by John S. Nicholas (14). Films on development are run once, and then run in the reverse direction. In many cases it serves as a logical approach to the study of development.

At another institution, a page of questions is provided before showing each film, these questions are discussed before projection of

the film. It was apparent that this was a very effective device for learning.

H. Field Trips

The use of field trips as a teaching practice was found in fifty-one courses. These trips sometimes include visits to museums. In seven other courses there were visits to museums. Table 6 indicates the frequency of the use of this exercise in the various kinds of courses. Field trips were taken to locations within a moderate distance, although in a few instances the trip was for overnight or for several days. The urban or rural location of the college, the climate, and the size of the class had considerable influence on determining whether this type of exercise was employed.

Wherever field trips were customary, the instructors felt that they were a very valuable and necessary part of the students' training. Few institutions were able to provide transportation for the students. Generally the trips were made in hired buses or in instructors' and students' cars. A serious situation has developed at some colleges where concern was felt about liability in case of accident. In some instances a special insurance policy to cover liability for each student was purchased, and in other cases the field trips have been abandoned.

I. Assigned reading

There was great variation in the requirement for reading assigned in addition to the required texts. Such assignments varied from a few articles to a wide and selected range. Table 7 indicates the numbers of courses in which additional readings were required:

TABLE 7

Number of Courses	Type of Course	Number of Courses Requiring Supplementary Readings
19	Integrated Biol.	10
25	Gen. Ed. Biol.	14
32	Zoology	8
5	Botany-Zoology	1
29	Botany	7
110		40

V. *Testing and grading*

Testing programs vary greatly. Most instructors have very strong opinions as to the best methods of testing. Information on final examinations for 120 courses is available. In only sixteen courses were the questions exclusively subjective, in forty-seven the questions were both objective and subjective, and in fifty-seven they were wholly objective. Of 119 courses, in seventeen the hour examinations were wholly subjective, in fifty-three, objective and subjective, and in forty-nine, wholly objective.

The objective questions varied from those which were excellently designed to others which showed inadequate understanding of this kind of testing. Reevaluation of objective questions after their use in examination was not a common practice. In a moderate number of colleges excellent facilities were available for correcting, for test evaluation, and question analysis. As a direct result of such aid the testing program and consequent reevaluation of the courses appeared to be much more effective.

Wide differences in the amount of testing were found. In a few courses tests were given weekly, in others a minimum of one midterm and the final examination were all that were required of the students. In a few cases no final examinations were given. Here the evaluation of the student was based on shorter and less comprehensive tests. At two institutions a comprehensive examination covering the entire course was used as the sole basis for the student's grade. However, in both institutions this policy is being changed in order to include the instructor's grade in the computation of the final grade for the student.

Some interesting testing practices were reported. At one institution, while a test is in progress the questions and answers are posted outside the examination room. Thus, immediately after the test, when his interest is great, the student is able to judge his achievement. In another institution, during the early part of the course, practice tests are given before an examination. Another instructor gives two copies of the examination to each student, one copy to be retained by the student.

At one institution an instructor gives no credit for an examination which is poorly written until the paper is rewritten in correct English. In a few instances, either one or two of the lowest quiz grades may be excluded from the calculation of the average grade. This usually occurs in a course where no provision has been made for making up quizzes which have been missed. In the case of absence,

every quiz grade is counted in averaging the grade.

The tendency in most biology courses in the past was to place strong emphasis on drawings or laboratory reports. Usually the grade assigned to such work was one in which subjective judgment played a large role. It was interesting to find some instructors grading laboratory work either satisfactory or unsatisfactory. Here the student's understanding of the laboratory assignment was appraised by a laboratory testing program. Regular laboratory quizzes, either oral or written, were a feature of a number of well integrated courses.

The conventional "practical" examination is used in the majority of the courses. This type of examination with its large number of specimens is generally a test of memorized items. However, in a few cases considerable ingenuity and thought on the part of the instructors produced practical examinations in which the student had to think through the problems presented.

The final grade for the student is computed in many ways. Sometimes no credit is given for laboratory work unless all other work is satisfactory. In a few colleges the calculation of the final grade from the laboratory and lectures is weighted on the basis of the credit hours for each portion of the course. Some institutions use a point system where each exercise is weighted in points. With this method the penalties for an unsatisfactory exercise may be greater than with other methods of evaluation. Pedagogically, this appears to be a dangerous practice, as poor performance on a single exercise might penalize a student so severely as to discourage any further effort.

Most instructors regard the final grade seriously and make special effort to avoid inequities. Subjective judgment is often used in adjusting the final grade.

The amount or kind of credit granted students for course work varies widely in different institutions. This, of course, is no new observation. College officials have long been faced by the problem of evaluating records from other institutions. Adding to the confusion of varying credits is the variation in the class hour. The shortest class hour was forty-five minutes in one institution, and the longest was sixty minutes. In addition, the laboratory hours may be longer than class hours as the time between periods may be incorporated into the total laboratory period.

Still further confusion results when credits for laboratory hours differ from the credits given for class hours. In some colleges students receive only 1/3 to 1/2 as much credit for laboratory hours as lecture hours. It is difficult to understand the basis for such arbitrary estimation of the student's effort.

The simplest plan and perhaps the one most acceptable pedagogically is in use at one women's college. Students usually elect four courses per year, and the instructor in each course expects the student to devote 1/4 of her available time to his course. One year credit is granted for each course completed successfully. Somewhat similar systems are in use at a few other colleges.

S. O. S.

If there was any doubt about the reader coverage of the ABT, the following item will probably settle it, at least for this year.

The information contained in Professor Weinberg's article in the May, 1959, issue, "A Simple Method for the Demonstration of Antagonism and Synergism of Biologically Active Chemicals" carried a reference that an "Antibiotic Diagnostic Kit" was available from Charles Pfizer Company, Brooklyn, New York.

The Pfizer Company has sent an S.O.S. to indicate that the demand for these kits now from teachers and student groups has far exceeded their supply. Dr. R. N. Shoemaker, Technical Manager, Public Relations Department, writes, "The kits, designed to aid hospital pathologists in the diagnosis and treatment of infectious diseases, have enjoyed the wide popularity that was foreseen for them and we are constantly asked to continue this service to the medical profession. Since our offer of these kits to high school teachers was made public we have found it extremely difficult to maintain our inventory position on these kits without curtailing our services to the medical profession. We have decided, therefore, that it would be in the best interests of all concerned, to limit the distribution of the kits to members of the medical and allied professions."

Undergraduate Do-It-Yourself As a Part of the Learning Experience

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While walking down the main corridor of the biology floor one day in the early part of the year, I was hailed by my department head who was proceeding in the opposite direction. In a short, sharp sentence I was asked, "How would you like to teach botany, second semester?" Being a zoologist and knowing that any second semester botany course would be for students who had flunked premed botany and general biology for nonscience majors I was hesitant to reply. But with little enthusiasm I agreed.

Could I present to these students, and in such a way that would hold their interest, a a strictly lecture course using the classical morphological presentation of botany? This was my problem. I concluded that, since they had had this approach in the previous semester it seemed ridiculous to take the same pathway. "Let the students do most of the work" was repeated to me many years ago by a very dear high school friend of mine. With these words in mind, I decided to take the do-it-yourself approach.

For the lecture periods I decided to have the students discuss the answers to outline questions that I had placed on the blackboard during the previous lecture period. For instance: 1. What is a living cell? 2. What do cells look like microscopically? 3. Why are living cells important to a living organism? etc. With such a series of questions, the student had to do his own research and then discuss his findings during the lecture period. The student was not totally lost in his quest for answers and discussion material since I had provided a reading list for each person. The results were astounding. I had never expected such lively and interesting discussions from this particular group.

The laboratory work was subdivided into four parts: 1. microscopic work (mostly morphology); 2. physiological experiments; 3. individual projects; and 4. oral reports. Parts one and two included the classical botany experiments and studies. For part three I suggested a number of basic projects which are used to demonstrate basic botanical and/or biological principles, but, with approval, the student was free to choose a project of his own interest which had not been suggested. When projects were completed the student or students if working in pairs, explained, during part of the laboratory period, his or their object, methods, and results. This part of the course was the most productive. One student chose to do a spectrum analysis of chlorophyll. From the physics department he borrowed large prisms and magnifying glasses and a conglomeration of other equipment which when put together resembled a Rube Goldberg invention. The whole thing, however, worked beautifully. Everybody in the class was thoroughly impressed.

The University student photographer was a member of this group and quite naturally was interested in taking photographs for his project. In time he had completed a very fine set of photo-micrographs of the various plant tissues.

Part four included oral reports taken mainly from the *Scientific American*. I chose articles most closely related to the course work. If we were discussing photosynthesis during the lecture period, an oral report on photosynthesis would then be given during some part of the subsequent laboratory period. The report would include the latest findings, and the whole field would be discussed in more detail than we had gone into in our previous lecture discussion. One student thoroughly shocked me by presenting an illustrated report. He had photographically copied diagrams, etc., from his *Scientific American* article and from other sources; these he projected through an opaque projector at the time of presentation. The semester finally ended with the students and me having gone through an inspiring and unique undergraduate teaching expèrience. I am sure that others who have tried this approach were similarly inspired. One observation should be noted, however; if a teacher rigidly follows a syllabus from beginning to end, the method presented will not work. It is quite impossible to cover a lot of ground, since some lecture discussions of a particular

topic may drag on for several lecture periods. Ordinarily the same material may be covered in two formal lectures. Perhaps in the case of biology majors or pre-meds where a great deal of material has to be covered, the system would have to be modified.

AIBS Visiting Lecturers Program for Secondary Schools

The success of the AIBS Lecturers Program aimed at the college level has resulted in considerable discussion within the AIBS Committee on Education and Professional Recruitment as to how the impact and effectiveness of this program might be further expanded.

It can now be announced that a program designed specifically for secondary schools will be started in the fall of 1959 to continue for at least one academic year. The National Science Foundation is providing funds for support of the program.

The operation of the program will be the same fundamentally as that of the college program. However, two changes have been made prompted by the different administrative structure of secondary schools.

First, requests for speakers will be honored only if made by the principal of a school or some other administrative officer. The requesting party must request the AIBS for approval of the speaker's itinerary and a statement of arrangements which have been made for his visit. In this way, the visiting speaker can be assured that he will have local administrative support for his visit.

Second, there will be no direct cost to the school involved. It is recognized that most school budgets do not provide funds for visiting lecturers and, as a consequence, would be hard pressed to invite distinguished individuals to speak to their students.

This program is another in a series of the services of the AIBS to improve biology teaching and to improve biological education in general.

Further information about this program may be obtained by writing Visiting Lecturers Program, AIBS, 2000 P Street, N.W., Washington 6, D. C.

The following scientists are a partial listing of the participating speakers. It is anticipated that others will be added before the program is initiated. Titles of the lectures to be given may be obtained from the AIBS.

Dr. J. L. Arbogast, Director, Clinical Laboratories, Medical Center, Indiana University, 1100 West Michigan Street, Indianapolis 7, Indiana.

Dr. William W. Ballard (Zoology), Department of Zoology, Dartmouth College, Hanover, New Hampshire.

Dr. Roger K. Brown (High School Science Teacher), University High School, Urbana, Illinois.

Dr. David E. Davis (Zoology), School of Hygiene and Public Health, 615 North Wolfe Street, Baltimore 5, Maryland.

Dr. Harvey I. Fisher (Zoology), Department of Zoology, Southern Illinois University, Carbondale, Illinois.

Dr. Dean Fraser (Virology), Department of Bacteriology, Indiana University, Bloomington, Indiana.

Dr. John L. Fuller (Physiology), Roscoe B. Jackson Memorial Laboratory, Bar Harbor, Maine.

Dr. Louis P. Gebhardt, Chairman, College of Medicine, University of Utah, Salt Lake City, Utah.

Dr. Helen M. Habermann (Plant Physiology), Department of Biological Sciences, Goucher College, Baltimore 4, Maryland.

Dr. Earl D. Hanson (Microbiology), Department of Zoology, Yale University, New Haven, Connecticut.

Dr. Samuel H. Hopper (Public Health), Department of Public Health, Indiana University, Indianapolis 7, Indiana.

Dr. James G. Horsfall (Plant Pathology), The Connecticut Agricultural Experiment Station, P. O. Box 1106, New Haven, Connecticut.

Dr. Theodore L. Jahn, Department of Zoology, University of California, Los Angeles 24, California.

Dr. Roy W. Jones (Zoology), Head, Department of Zoology, Oklahoma State University, Stillwater, Oklahoma.

Dr. Walter A. Konetzka (Bacteriology), Department of Bacteriology, Indiana University, Bloomington, Indiana.

Dr. Addison E. Lee (Botany), Department of Botany, University of Texas, Austin, Texas.

Dr. Kornelius Lems, Department of Biological Sciences, Goucher College, Baltimore 4, Maryland.

Dr. Ariel G. Loewy, Chairman, Department of Biology, Haverford College, Haverford, Penn.

Dr. Robert W. Pennak, Department of Biology, University of Colorado, Boulder, Colorado.

Dr. S. N. Postlethwait (Botany), Department of Botany, Purdue University, Lafayette, Indiana.

Dr. H. W. Seely, Jr., Department of Dairy Industry, New York State College of Agriculture, Cornell University, Ithaca, New York.

Dr. Charles W. Schwartz (Zoology), Department of Conservation, 131 Forest Hill, Jefferson City, Missouri.

Dr. Leland Shanor (Mycology), Head, Department of Biological Sciences, Florida State University, Tallahassee, Florida.

Dr. Walter P. Taylor (Zoology), 3438 Marvin Avenue, Cleveland 9, Ohio.

Dr. Howard H. Vogel, Jr. (Radio-Biologist), Argonne National Laboratory, Box 299, Lemont, Illinois.

Dr. Paul B. Weisz (Embryology), Professor of Biology, Brown University, Providence 12, Rhode Island.

The ANSS and Natural Resources for the Future*

IRA N. GABRIELSON
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During the past fifty years, under the impact of the Machine Age, America's landscape has undergone vast changes from the semi-rural culture of the turn of the century to the highly urbanized complex of the present. Many a city dweller of today visualizes meat only as something that comes from the supermarket, neatly packaged and wrapped in sterile cellophane; milk as a white substance that appears miraculously on the doorstep in cartons or bottles so long as the bills are paid; and water as something that flows endlessly from a chrome-plated tap at the will of the user. On a large segment of the public, the fact that meat, milk, and water are direct products of the soil has been lost in a great maze of high-pressure advertising and modern specialization.

Even the farmers, for the greater part, are now specialists in wheat, corn, hogs, or beef, and the old-time general farmer, who raised practically all of the family needs on his own few acres and traded the surplus for bolts of calico or legal services, has become a fading anachronism. As our society has grown more complicated, the distance between the plot of soil that raises the food product and the ultimate consumer has stretched from a few rods to many hundreds of miles. Iowa corn may fatten Vermont turkeys that will be served on tables in San Francisco, and wheat raised in the Dakotas is converted into flour in Minneapolis for consumption as bread in Florida. From the standpoint of the nation's economy these developments are generally good, but often they tend to blind the consumer to basic natural resources problems. The old-time farmer whose water supply came from a spring on a nearby hill knew the importance of keeping forest fires away from that hill and grazing area sparingly if at all. It is somewhat more difficult for the apartment dweller in the city to see that the same principles apply to his own water supply when his own water tap is separated from the source by some fifty to a hundred miles of cast-iron pipe.

A major part of the job of the modern nature teacher is to bridge this vast gap of understanding. Rather than becoming simpler, the problem of supplying the needs of a nation of 175 million people is perhaps ten times as difficult as it was for a nation of 100 million. New processing methods consume huge quantities of water, and some new products require in their manufacture as much water as was consumed for all purposes at the beginning of the century. Plans now in the blueprint stage for future developments promise still further heavy uses of water in the coming years with little promise of an increased supply.

Aside from the fundamental needs of food and clothing, America is losing many of the spiritual and esthetic values of natural resources, and these values are assuming increasing importance as population pressures build up. A major part of the present suburban movement is a somewhat futile attempt by Americans to escape from the crowding of city life and to get closer to nature. The preservation of the outdoor recreation these people want—whether it be birdwatching, boating, hunting or fishing—will depend upon how well we manage to preserve some of the natural areas which must provide the environment for these sports in future years.

Few greater or more important tasks can be performed by the members of the American Nature Study Society than to impress upon their pupils the values of remaining natural areas and the importance of managing the land to produce maximum material and recreational values consistent with essential material needs.

During the coming years it will become increasingly necessary for teachers of biology and nature study to drive home facts concerning the interrelationships of livng things—including man—with one another. We have specialized in every field, even in natural resource management, to the extent that some foresters see woodland values only in terms of saw logs; some agriculturists regard any plot of land not producing corn or soybeans as wastelands; and

*Presented at the annual meeting of The American Nature Study Society, Washington, D. C., December 27, 1958.

many engineers consider any water area, whether marsh, stream or lake, as worthless until filled, channelized, leveed, or drained. The fact that these areas may be important recreational areas providing a brief escape from a world increasingly filled with man-made noise is lost on such people. They also may never fully understand that the draining or filling of a coast marsh area may affect the importance of local commercial fishery catches; that the draining of potholes in the Dakotas may deprive hunters on the marshes of Louisiana of a day of sport; that the exploitive cutting of a forest area may destroy the recreational values of streams far below the lumbering operation; or that forest fires and overgrazing may destroy or seriously impair the water supplies of large cities.

A second contribution that teachers of nature study and biology can make in future years is an improvement of the accuracy of information passed on to others. Many of the myths, half-truths, and fallacies that filled the early literature of natural history have been buried, but, unfortunately, some of these heritages from a less enlightened past persist to the present in the writings of some popular writers, in the lectures of untrained teachers, and in a substantial portion of the public mind. Some of these fallacies may be attributed to limited personal observation but stem from lack of scientific training and from prejudices traceable to superstition, folk-lore, and myth.

A common failing of many nature writers is the use of the anthropomorphic concept of "good" and "evil" when applied to members of a natural community. This idea originated many centuries ago with fabulists like Aesop and LaFontaine, but it has been perpetuated by modern writings, even of people claiming to be serious nature teachers. I have no desire to see children deprived of the pleasures of the classic fables and fairy stories, but it would be good to see a more objective approach on the part of responsible authors and lecturers on nature study.

The anthropomorphic concept is familiar to all of you. One of its common themes is that the grazers and browsers, such as deer, rabbits, and sheep, are virtuous "friends of man" while the carnivores are the perpetual villains of the natural drama, thirsting for the blood of the innocent, and conflicting with the interests of the farmer and of humanity at large. Anyone who is familiar with wildlife management problems today, however, should be aware of the fact that overpopulations of wild grazing animals are creating greater economic problems than the depredations of all predatory mammals combined. Elk and deer, the two worst offenders, have increased in number so rapidly in many places that they are threatening watershed values, destroying valuable forest reproduction, and presenting a threat to local agricultural efforts. These problems in turn are traceable, at least in part, to the extermination of wolves, pumas, and other predators under campaigns often initiated and supported by sportsmen and nature lovers to protect the herbivores.

Predation, in the absence of other effective population controls, is essential to the well-being of the prey species. It tends to keep herds of browsing and grazing mammals in balance with their food supplies, minimizing overcrowding that causes mass starvation, lowered reproduction, malnutrition, and disease. Even heavy seasonal hunting has not been able to prevent general overpopulations of deer and elk over the ranges of these species in America.

A second common misconception among otherwise well-informed nature students is that a native predatory species can exterminate more desirable local wildlife populations or that seed-eating birds exert important controls over undesirable plants. When one considers the abundance and fecundity of plants, with a single seed pod or flower head producing from fifty to ten thousand seeds, it can be seen that even large concentrations of birds could do little more than exert the most local control over the spread of any one plant species. Predator-prey relationships are similar in their basic mechanics. The unbalance of reproductive potential between prey and predator also applies here. Then, too, few predators single out one species of prey to attack to the exclusion of all others, since most of them are hunters of opportunity, taking what is most readily available, and transferring their attention to more abundant or more easily captured forms when the first is reduced below levels of abundance.

By dispelling these and similar fallacies from the literature of nature study the members

of the ANSS can make an important contribution to a clearer public understanding of the relationships between living organisms. But from the broader standpoint of the future of man, the greatest contribution that this Society can make would be to instill in others what Aldo Leopold called "the ecological conscience," an awareness of the interrelationship between various natural resources as well as between plant communities and animal populations, between human welfare and the condition of the soil and water, between land management and water supply, and between wildlife populations and forest resources. Possibly if we had had a few more nature teachers with an ecological conscience fifty years ago, many of our present problems would have solved themselves without the sometimes bitter controversies that have marked the conservation movement in recent years.

Natural History of Some Bird's Nests

JAMES M. SANDERS
Chicago Teachers College, Chicago, Ill.

During the last few years at every opportunity we have been collecting authenticated birds nests—that is, nests upon which the occupants have been observed and adequately identified.

Many of these subsequently vacated nests have been collected, sprayed with plastic or shellac to hold them firm, and then set into soft plaster of paris which hardens into a block holding the nest. This block acts as a base and protective support. The nests are then exhibited or loaned to college students doing pre-practice or practice teaching and are used in elementary classrooms. Such a rotating collection is serviceable and very functional.

A few nests which were atypical in some respects deserve mention. We have a male wren's "nest" or accumulation of materials which was abandoned by the bird and then used temporarily by flying squirrels which burrowed into one end and started to line it for living quarters.[1] Another male wren's preliminary effort was preempted by house or English sparrows, rearranged into a nest and used to hatch out and bring up young. This nest was in a corner on the plate or timber supporting the rafters of the porch of the lodge at Camp Sagawau.[2] A stimultaneous nesting occured in the exactly opposite location at the other end of the porch. This nesting was established by a pair of house wrens, and eggs were laid. Then the other end of the long pile of nesting materials was arranged into a nest by English sparrows. This invasion was vigorously opposed by the wrens with commotion, scolding, and aggressive activity toward the sparrows. The sparrows also produced eggs. The wren brood hatched, matured, and were away before the sparrows. The sparrow brood was removed when the young were well feathered and the nests sprayed and collected as a single mass or unit.

A phoebe's nest, carefully tufted on the outside with moss which became a continuous, green, living, outer cover was discovered on a window frame of one of the sleeping or dormitory cottages. This nest was built atop another which still contained eggs. The nest was shellacked and a careful vertical section made with a section razor to confirm the number of layers or successive nests. The eggs in the lower nest were not positively identified as belonging to a phoebe. The lower nest was quite evidently a phoebe's nest.

[1]The nest was built in a cardboard carton tacked to the side of his cottage in the Cook County Forest Preserves by Dr. David Thompson.

[2]Camp Sagawau is a permanent camp reserved by the Cook County Forest Preserve District for educational purposes and was occupied by Chicago Teachers College as a summer Nature Camp offering graduate work in biology.

Conservation

The *Bulletin for Medical Research*, January-February, 1959 issue, is devoted exclusively to "Biological Research in Conservation." It is an excellent survey of some of the outstanding areas in conservation. Copies may be obtained from the National Society for Medical Research, 920 South Michigan Boulevard, Chicago 5, Illinois.

Conservation Experiences for Teachers

HOWARD H. MICHAUD
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Much has been said about providing real conservation experiences for teachers so that they may be better prepared to teach conservation. Numerous workshops and summer courses in conservation are available over the nation for teachers. Some of these are given on college campuses. While campus courses are a necessary expedient for both pre-service and in-service teachers the best opportunities are provided at a camp where an outdoor atmosphere prevails.

A prospective teacher in a three semester-hour campus course recently asked, "Do you think we can really learn enough in one semester to teach conservation adequately?" It was encouraging to the instructor that one student, at least, recognized the extensive area of knowledge that conservation encompasses.

Another prospective teacher majoring in conservation for a master's degree recently amazed one member of the examining committee by the wide range of information the candidate was expected to know. Not only did his major area cover soil, water, forest, and wildlife conservation, but minors in ecology and agricultural economics.

It certainly is not intended to advocate that every teacher of conservation must be completely informed in every special area of conservation. It is believed however, that exposure alone is not enough. Many of us are commonly exposed to all sorts of information without any of it becoming usable knowledge.

Teachers should have an opportunity to engage in a number of real conservation experiences out-of-doors, preferably in a camp situation, in order to gain a genuine feeling for the meaning of conservation. Whether it be for a week, or considerably longer, there should be ample occasion for the teacher to make full use of his sensory contacts with as much of the environment as possible.

The accompanying illustrations and account of conservation activities are examples of what the Indiana Conservation Education Camp for teachers, held each summer at Versailles State Park in southeastern Indiana, considers real conservation experiences.

Two primary problems in soil conservation

The ecology instructor explains some of the many biotic complexities of the deciduous forest floor.

are to reduce erosion and to maintain fertility levels. Contour farming is employed to make water walk, instead of run, downhill in order to reduce erosion. Establishing a contour line on a hillside is a basic procedure for plowing on the contour, strip cropping, and building terraces. A carpenter's level mounted on a five foot pole (2″ x 4″), or a hand sighting level are simple tools that are provided to enable teachers to stake out a hillside contour line.

On another occasion, three different sized corn plants were selected from a field where the season's record of fertilizer application was known. Plant tissue tests were made to determine the presence of nitrate, potash, and phosphate. This particular test showed adequate amounts of nutrient material in each sample. The difference in size was found to be due to varying degrees of root fungus attacking the plants. Conclusions were based on scientific observations and actual experimental method.

Several days in the field with a geologist provides actual contact with the shales, sandstones, limestones, and glacial deposits in the vicinity of the camp. The development of soils in relation to climate and parent material of the area is more clearly understood after the teacher has become familiar with the local mineral rock resources. The simple acid test for limestone, the gritty feel of sandstone, and the earthy smell of shale are helpful sensory

Daily weather data is recorded and students make a twenty-four hour forecast.

contacts that contribute to a knowledge of soils.

After teaching geology for several years at camp, the instructor decided to require a simple rock collection of twelve specimens, including examples of sedimentary, igneous, metamorphic, and fossil rocks. Both the students and instructor have come to realize that the collection has greatly increased the interest and understanding in geology. This knowledge spreads far beyond the simple process of naming rocks. It opens the pages of geologic time.

The underlying bedrock of the park is Ordovician limestone and offers a rare opportunity to collect an abundance of brachiopods, bryozoa, gastropods, and an occasional trilobite. From the heritage of Ordovician time, through the more recent ages of glaciation, there were many changes in climate, physiography, and biota that contributed to the natural resources as we see them today.

A weather station is maintained at the camp to enable teachers to follow daily changes in barometric pressure, relative humidity, maximum and minimum temperatures, wind direction and velocity, cloud formations, and rainfall. Records are kept and daily weather predictions are made as an incidental feature.

Climatic observations are related to ecological studies during a portion of the course. Rain gauges, thermographs, and atmometers are set up in three contrasting micro-climates to record the differences for example on (1) a north-facing wooded slope, (2) a south-facing wooded slope, and (3) an open exposed meadow. Teachers are quite impressed with the marked variations recorded in the various habitats. Such field work leads to an appreciation of environmental influences affecting plant and animal communities.

The shortage of water in the local community of Versailles has been one of the primary factors in limiting its economic expansion. Its water supply, obtained from a small stream, yields about one-fourth to one-third that of normal consumption for the rest of the state. Students at the camp last year were able to observe the development of a new lake in the park. The 1958 camp saw the benefits in a new water supply for Versailles as well as increased recreational facilities for the surrounding community. Also, they saw the problems of siltation due to inadequately vegetated lands in the upper watershed and the problems of providing structures to take care of the expanded recreational demands for use of the lake.

One of the important problems in forest conservation in the central hardwoods is to encourage the growth of the high quality timber species through better woodland management. A local farm woods in the vicinity of the camp offers an unusual situation for teachers to gain first-hand information on a scientific evaluation of the rate of timber growth. Permanent growth study plots have been established by the area extension forester and each tree is numbered so that the annual increment may be recorded.

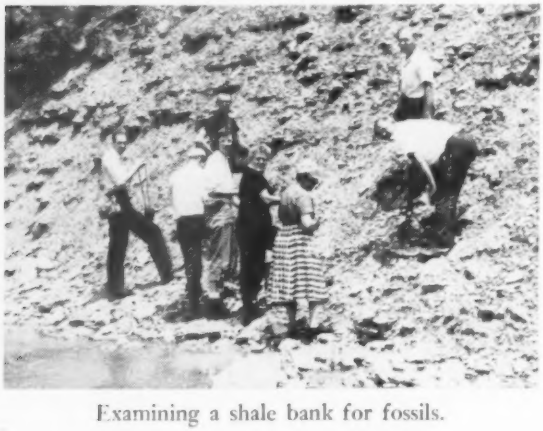
Teachers are each assigned three trees and are asked to determine the species, measure the diameter, and estimate the timber volume of

Collecting stream fauna to show the relation of these organisms to this particular habitat.

each. The results can be checked against the forester's record. This experience impresses the students with the importance of rate of growth to timber harvest. They learn as the farmer has learned that it is economically sound to let trees grow as long as the rate of growth is high and to harvest them when growth rate slows to the point of diminishing returns.

A great popular demand for the recreational pursuit of our fish and wildlife resources necessitates an extensive program of research studies to maintain the best possible rate of wildlife production. Using our fisheries resources as an example, a valuable project is undertaken through which a comparative study is made of the biology of a stream and of a farm pond. The class is divided into two groups. Each is given a seine, a bottom sampler, collecting bottles, and formalin preservative. Samples of fishes, crustacea, molluscs, insect larvae, and water vegetation are brought into the laboratory for identification and study. The interrelations of the biota in each habitat are emphasized. The difference in stream and pond communities is distinctly impressive. Without the effort involved it is inconceivable that a cursory examination of the separate habitats would express the same understanding of fish management problems.

The value of improving habitat to benefit wildlife can be readily recognized on a number of the farms in the county. Rabbits and quail are abundant on several farms where some planned attention has been given to furnishing suitable interspersion of cover. Crop land, forest land, and meadow are interspersed so that each cover type is within easy reach of game. Good travel lanes are planted to multiflora rose that serve as a living fence. Pines and various kinds of lespedeza are used for erosion control, borders, and to provide wildlife cover on what otherwise would be waste places on the farm. These areas are quickly identified by teachers as being highly productive for game and that they will provide an annual crop for the hunter.



Examining a shale bank for fossils.

Laying out contour lines with carpenter's level.

It should be remembered that conservation is for people. Several days at camp are devoted to a discussion of the social and economic relations of conservation. Problems of competitive and conflicting uses of land, suburban encroachment on land, and the need for effective planning are not overlooked. An approach to the solution of these problems is far more intelligent when based on the knowledge about resources that has been experienced at the camp.

Space does not permit a complete account of the conservation experience available at the camp. The "proof of the pudding is in the tasting" and only those who have participated in the program are fully aware of the advantages it offers.

The Fire Ant

A resolution was adopted at a recent meeting of the American Society of Ichthyologists and Herpetologists concerning the fire ant eradication campaign. The resolution calls upon the U. S. Department of Agriculture to cease the use of chemicals now used in the Southeastern states for the eradication of the fire ant. Copies of the resolution may be obtained from Roger Conant, Secretary, American Society of Ichthyologists and Herpetologists.

Assurance of Living Frogs for Experimentation: A Technique

ROBERT E. BROWN
Greenport High School, Greenport, Long Island

In the standard biology course there always seems to be a need for living specimens of one sort or another at the wrong time of the year. We have found that our one biggest headaches is ensuring ourselves of a good supply of frogs at the time when the class is considering topics such as circulation, the nervous system, etc. This usually finds us in mid-winter. Frogs are expensive when we buy them in the quantities needed, and it is bothersome to have to order and wait for the frogs.

At Greenport High School we have found a method which has proved amazingly successful in maintaining a living collection of frogs for an extended period of time.

To review a few facts about frogs: we know that frogs are poikilothermos, and we also know that frogs enter hibernation with the onset of cold weather in the fall. We have a good idea of what frogs eat and also how much. The problem, then, is how to take advantage of the frog's natural hibernation tendency and also keep them alive.

In early September, the members of the biology class who were going to treat this as a special project, collected twenty frogs of varying sizes, all *Rana catesbiana.* When the frogs were brought to the classroom they were established in a twenty gallon terrarium. Peat moss was used for the base and this was saturated with water. Three sides of the terrarium were covered with dark paper with the front and top left open to the class. In the two weeks that followed, the frogs were fed, bathed and had their habitat cleaned once each week. The feedings consisted of about three ounces of raw liver per frog. This had to be forced down the frog by a rather interesting technique. The three girls who performed this rather strange operation considered themselves fortunate to have six hands available for the work. Girl number one held the squirming, complaining frog; girl number two pried its mouth open with a pair of forceps, and girl number three placed the meat in the frog's throat and proceeded to tamp it down into the stomach by means of a glass rod. The frog was then rinsed under cold water and placed with its freshly fed brothers.

Frogs getting weekly bath

Feeding time takes five hands

In this manner we were able to build up the strength of the frogs and make sure all of them were well fed. We then decided that it would be much easier to have just a few frogs around to feed rather than the entire family. The healthiest looking specimens were selected and put into forced hibernation. Checking the refrigerator, we found that the temperature was 10° C, and that the natural moisture of the interior was sufficient to keep the frogs at an optimum hibernation environment. We placed six frogs in a clean gallon

mayonnaise jar and placed this in turn in the refrigerator for a period of one day. This took the metabolic rate of the frogs down to the inactive state, and we were able to handle them more easily the following day. We then wrapped the frogs completely in moist cotton and placed them in the jar like so much cordwood. With an occasional check we were able to keep the frogs in this state for four weeks at a time. At the end of this period we took out the hibernating frogs, warmed them for a day, and then fed them their first meal in a month. We replaced these frogs with a fresh group so that at no time did we have to feed, clean, and worry about more than half a dozen frogs.

We found this method most effective and interesting, and it assured us of a supply of frogs for pithing, circulatory study, etc. The frogs were actually in a state of inactivation and consumed their stored food supply since metabolism continued during this period. The loss of weight amounted to six or seven grams, and there was a noticeable change in the physical appearance of the frog. The most obvious change was the color change. The frogs were a dark green when they entered their frosty chamber, but they emerged a bright yellowish green. At no time did any of the frogs lose consciousness completely. They all responded to the stimulus of a pin-prick, thus indicating that they were still in this world.

As I have previously stated, the advantage of this method is the fact that we were certain of a fresh supply of frogs, available at a day's notice, whenever we needed them. The students were also able to witness first hand some of the mysteries of hibernation and were actually able to see what all the business of assimilation, circulation, absorption and or metabolism means when witnessed in a living animal.

There are certain precautions which should be taken in repeating this experiment. Only the healthiest frogs in the groups should be subjected to the rigors of this forced hibernation, and they should be well fed beforehand. The temperature and moisture content of the refrigerator are most important and should be carefully controlled. It is also advisable to subject the animals to succeedingly longer periods of isolation rather than starting at the ultimate period of four weeks. Some species will probably be able to endure for longer periods than others. Only individual class experimentation can discover the exact length of time.

A Botanical Wonder for the Science Teacher

GERALD P. HIRSCH, *Ithaca, New York*

Wild orchids growing from decaying trees —Banana plants with sharp, serrated leaves— The smell of a tropical rain forest—

Is this a South American jungle or an African swampland? Neither! It's any large city, U.S.A., where teachers confront both juvenile delinquents who roam tree-less streets and serious biology students who read and dream of rain forests, swamps, and deserts.

In most cases, the delinquent requires a psychologist, but the serious student needs the rain forest, jungle, or desert. How can you, the city teacher, satisfy the science student's needs? Oddly enough, the yellow pages of your phone book, or a directory to city parks and buildings offer some answers.

The yellow pages give the location of numerous commercial greenhouses. City guides locate some of the world's finest botanical collections.

Even with snow on the ground, and jungles and deserts hundreds of miles away, you need not worry about the student who wishes to see a live orchid or a Venus flytrap. A bus or train will get you and your class into tropical rain forests or desert regions within minutes.

For demonstrations of reproduction, plant growth, plant ecology or plant varieties there is no better classroom than the local greenhouse. For the student, there can be no greater interest than tables covered with tropical plants, some flowering, others with fruit, and some just beginning to grow.

Everyday experience can be used to arouse student interest in greenhouse plants. The African violets in Mom's kitchen are propagated from leaves grown in the greenhouse. Orchids that John gives Mary for the big dance are first grown in flasks then trans-

planted to flower pots where they mature. Bryophyllum leaves are placed on moist soil, and from the leaves' margins grow new plants. Leaves of a Venus flytrap close tightly on the fly that touches three little hairs located between the leaves. An endless array of botanical wonders are present to gain and keep the attention of the students while you explain the whys and hows of each phenomenon.

The trip to the greenhouse should be planned at least a week in advance. If you're planning to take the class to a local greenhouse, then visit the greenhouse a few days prior to the formal trip and get to know your way around. Decide on plants to discuss, then write their names in a notebook. Find out a little about each plant, more than the pupils might know or want to know.

Having chosen the most interesting plants, those plants that will satisfy what you plan to demonstrate or teach, then write out your teaching procedure. A simple example would be:

1. Varieties of plants
   a. Darwin's theory
   b. Hybridization
   c. Mutation
2. Photosynthesis
   a. Chlorophyll and leaf pigmentation
   b. Seasonal color change
3. Reproduction
   a. Sexual
   b. Asexual (vegetative)
4. Ecology
   a. Evergreens
   b. Mosses
   c. Ferns

It should not take long using a few varieties of plants to cover all of the above topics. For this, you could use orchids from the South American jungles, sundews from the American marshland, and ferns from both woodland and jungle. Here are different types of ecology, various forms of reproduction, and unusual habits. The limit as to what can be taught or observed depends on the amount of available time.

Most greenhouse men would be willing to give cuttings from the various plants to your class. Thus, students can follow along while you demonstrate the difference between "stigma and stamen." Many greenhouses conducting experiments will supply you with information concerning the projects. Such experiments as: why certain plants bloom only when the amount of daylight is short compared with the amount of darkness, while other plants act conversely, will prove interesting to the class.

Many greenhouse scientists are experimenting with both nutrients and plant growth. A biology topic on essential food elements or growth hormones could be covered in a greenhouse where nutrient and growth experiments are being conducted.

Student attention can be kept while topics of photosynthesis and ecology are taught. Students with cameras will enjoy taking pictures of the many varieties of individual flowering plants or plant displays.

Back in the classroom students can begin class projects using a corner of the room as a model greenhouse. They can make charts using the photos they took depicting plants in their native environments or the plants' reproductive cycle. The students could use these models for teaching other pupils about the wonders of the plant world.

Greenhouses are found in every city. Learn where they are and use them. The interested science student need not dream of jungles, swamps and deserts, for you can take him there in minutes.

Booklet on Microscope Available

"Your Microscope and How to Use It" is available from the Science Materials Center, 59 Fourth Avenue, New York 3, New York, at 70 cents. It also is included in a $12.95 microscope kit packaged and distributed by the Center. The kit contains, in addition, a good beginner's microscope with three objectives and two eyepieces, giving up to 300x magnification, materials for making permanent slides, a set of prepared slides, an illuminator, and a set of accessories. Intended for use by children of ten years and older, as well as adults, the booklet is applicable to any standard microscope now on the market.

Beginning with a diagrammed explanation of the parts of the microscope, the booklet continues with detailed instructions for focusing, lighting, preparing slides, cleaning, handling, and photographing through the microscope. Basic work habits leading toward skillful scientific observation are outlined, with suggestions for specific experiments and study hints.

Techniques of Close-up Photography with a Single-Lens Reflex Camera*

MARVIN R. BELL

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The single-lens reflex camera differs from the conventional camera in that the latter is focused by means of a view-finder that is somewhat removed from the camera lens. This is of little consequence when taking pictures of objects some distance away but does make a difference in close-up work as will be explained below. The double-lens reflex camera has a full size viewing plate which permits sharp focus and accurate composition. The viewing lens is separated from the "taking" lens far enough to create the same problem in close-up work as is encountered with the conventional camera, and for the same reason. This difference in viewing and taking line of sight is known as parallax which can be compensated for by raising the camera or by using an anti-parallax device.

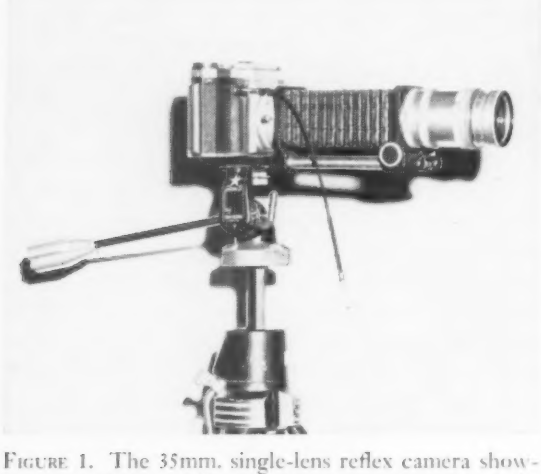

FIGURE 1. The 35mm. single-lens reflex camera showing an extension bellows and a 50mm. extension tube set inserted between the camera body and the lens.

The single-lens reflex camera views and focuses through the same lens that takes the pictures, thus eliminating inaccurate focus and composition regardless of how close the lens is to the subject. This is accomplished by means of a 45° mirror set beneath the ground glass viewing plate. This mirror comes down into viewing position when the shutter is cocked and goes back up away from the film when the shutter is released. The operator always sees exactly what the film "sees" regardless of the distance between the lens and subject.

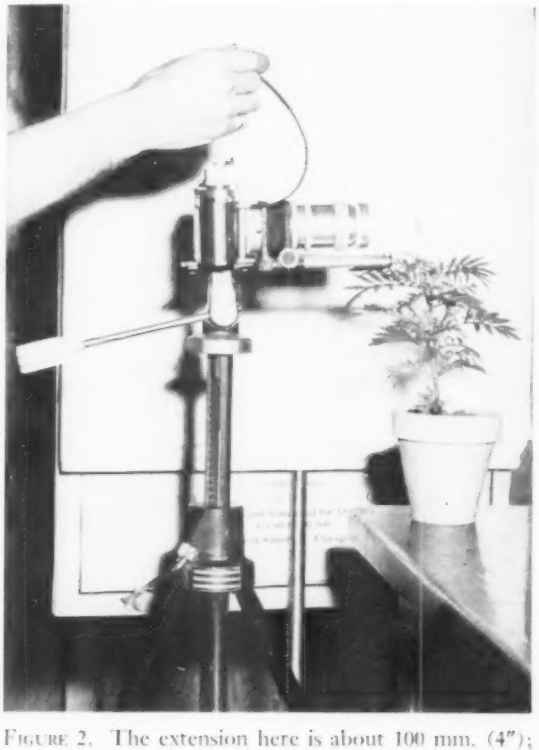

FIGURE 2. The extension here is about 100 mm. (4"); the magnification is 2X. Note the use of tripod and cable release to reduce vibrations.

Techniques in close-up work. Close-up photography (not photomicrography) may be accomplished in two ways. For cameras not having removable lenses, supplementary lenses may be used. These are commonly referred to as "portrait" lenses and are simply slipped over the camera lens to give added magnification. Unless the camera used is of the single-lens

*Presented at the NABT sessions during the AAAS meetings in Washington, D.C., December, 1958.

reflex type, the focus usually is determined by measuring and the picture composed by using a framing device made of bent wire, attached to the front of the camera, or some other anti-parallax device.

Extension devices. The second method is based on the principle that the closer the subject is to the camera, the larger its image will appear on the film, and the closer the subject is, the farther the lens is moved away from the film to bring it into focus. But there is a limit to the distance the lens can be screwed forward. With cameras having removable lenses this distance can be increased considerably by inserting rings, tubes, or adjustable bellows between the lens and the camera body, Fig. 1. Extension tube sets commonly consist of three or more tubes that can be used separately or in any combination. Thus a 50mm. tube set has three tubes, one 5mm., another 15mm., and a third 30mm. Possible extensions with this set are 5mm., 15mm., 20mm., 25mm., 30mm., 45mm., and 50mm.

Extension bellows accomplish the same results, with the added advantage of (1) extending farther, and (2) continuous extension from about two inches (50mm.) to six inches (150-mm.). Extension tubes and extension bellows can be used in combination with each other.

Magnification. The amount of magnification depends upon the focal length of the camera lens and the amount of the extension. The normal lens on most 35mm. (size of film) cameras is 50mm. This means that the lens is 50mm. (2 inches) from the film. If by means of extension this lens can be moved another 50mm. from the film the subject will be in focus on the film when it is 100mm. from the lens, and the image will appear full-size on the slide. Thus, any extension beyond the focal length of the lens will produce a picture that is actually magnified on the film. A small object, magnified four times, may still be small on the slide, but when projected to the screen it will appear quite large.

The depth of focus becomes narrower as the lens is moved closer to the subject, and at very close range it becomes critical. This is not the case with very flat subjects, nor with copying, so long as the subject is in the same plane with the film. The depth of focus can be increased some by using a small iris opening and increasing the time of exposure accordingly. The lack of depth of focus may not always prove undesirable, because a blurred background may enhance rather than detract, and very small dots of bright light appear on the slide as small or larger circles of light depending upon the extent to which they are out of focus.

This shallow depth of field increases the need for very careful focusing. This is always done through the magnifying glass over the viewing plate and with the iris at its largest opening. The iris is stopped down to the desired opening just before releasing the shutter.

Another precaution here is that the camera and the subject must both be perfectly still at the moment of releasing the shutter. The slightest movement will cause the picture to be blurred. The work must be done where there is an absence of air currents, if the subject is of light material. A cable release should be used to reduce any vibration caused by releasing the shutter. For the above reasons, the camera must always be supported on a tripod or other solid object, Fig. 2.

Exposure. Because the light must travel a greater distance from lens to film in close-up work, it is necessary to increase the exposure time or to use a larger iris opening. It must be remembered, however, that the larger iris opening decreases the depth of focus, so it is better in most cases to use the smaller opening and increase the time proportionately. The accompanying table gives data on this and other information for several extensions from 5mm. to 175mm.

The extensions are found in the first column, see table. Fifty millimeters (the focal length of the lens) added to each of these gives the lens-to-film distance found in the second column. This lens-to-film distance is used in computing the effective apertures for the extensions given in the third column. The exposure and aperture, determined by a light meter, are taken to be 1/25 second at f/11 when no extension is used. The proper aperture for 1/25 second for any extension can be calculated by the equation: $A = a \times \frac{f}{f+e}$, where A is the effective aperture for the desired extension: a is the indicated aperture (from light meter); f is the focal length of the lens; and e is the amount of extension. Example: The light meter calls for 1/25 second at f/11, and 50mm. of extension are used with a 50mm. lens. $A = 11 \times \frac{50}{50+50}$ or A = f/5.5. The new setting is now 1/25 second at f/5.5.

Extension	*Lens to Film*	*Normal Exposure 1/25 at f/11*	*Magnification*	*Lens to Subject*
5mm.	55mm.	set at f/10.	.1X	18"
15mm.	65mm.	f/ 8.5	.3X	9"
20mm.	70mm.	f/ 7.9	.4X	6¾"
30mm.	80mm.	f/ 6.9	.6X	5½"
50mm.	100mm.	f/ 5.5	1.0X	4"
75mm.	125mm.	f/ 4.4	1.5X	3½"
100mm.	150mm.	f/ 3.7	2.0X	3⅛"
130mm.	180mm.	f/ 3.1	2.6X	2⅞"
175mm.	225mm.	f/ 2.4	3.5X	2⅛"

TABLE

Column 1. The amount of extension provided by extension tubes and/or bellows.

Column 2. The lens-to-film distance is equal to the focal length of lens (50mm.) plus the amount of extension.

Column 3. The f/value applicable to the various extensions when the exposure remains at 1/25 second.

Column 4. The magnification is found by dividing the extension by the focal length of the lens.

Column 5. These distances are only close approximations of the exact mathematical values, and may vary due to depth of focus, and the fact that the lens can be adjusted from "3 ft. to infinity."

If the larger apertures do not give enough depth of focus for a particular subject, the time can be computed for a smaller opening. If the same f/value is used (f/11 in our example) the time must be increased for any extension beyond infinity. This calculation is accomplished by the equation: $A=a \times \frac{f+e}{f}$. It will be noticed that this equation is an inversion of the first one. Using the same examples as before, $A=11 \times \frac{50+50}{50}$ or A=f/22. The aperture is set at f/11 but the time is computed for f/22 which would be 4/25 second rounded off to 1/5 second.

It may be noticed that some difficulty is encountered in setting the time and/or aperture exactly as calculated. Experience indicates that there is some latitude and that the settings are not too critical. Some judgment needs to be used in the case of very light or very dark subjects.

The fourth column lists the magnifications to be expected from the various extensions used and may be quickly calculated by dividing the extension by the focal length, $\frac{e}{f}$. Thus a 100mm. extension of a 50mm. lens would be $\frac{100}{50}$ or would magnify the subject 2X, provided the lens-to-subject distance is exactly 4 inches (100mm.).

The fifth column shows the approximate distances from lens to the subject, a distance which may vary, because of the depth of focus, and the fact that the lens can be adjusted from "three feet to infinity." This variation is greatest for the 5mm. extension being from 12 inches to 18 inches in this case, and proportionately less, as more extension is added. All measurements in this column were taken with the lens set at infinity and not determined mathematically.

Cheerful Drug

One of the agents, called nialamide, that make laboratory animals more cheerful was found to be effective in overcoming mental depression—induced in the animals by the injection of the mental drug reserpine—and less toxic than antidepressive drugs now available to physicians, according to Dr. Barry M. Bloom, research chemist with Chas. Pfizer, Inc., Brooklyn, N. Y. Depression is perhaps the most widespread of all mental disorders, medical authorities say.

In the animal tests described by Dr. Bloom, some of the new compounds were as much as twelve times as active as iproniazid, currently the most widely used anti-depressive drug, and had a longer duration of action, Dr. Bloom noted. Side effects, such as lowered blood pressure and jaundice, were absent.

Recording Bird Calls

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Do you have two or three exceptionally capable biology students who have a flare for electronics? It may be possible to increase their motivation and their contribution to class if they became interested in making tape recordings of bird calls. Some species of birds are available at or near most schools. This project would involve other areas of learning such as physics of sound and the mechanics of constructing some equipment.

A tape recorder with a long extension cord would suffice in some localities. If the school possesses an inverter for direct current the recorder can be used from a car. Although a car makes an excellent blind, it still may not permit one to get close enough to some birds. In such cases, a parabolic reflector attached to a tripod is a great help. If a parabola is not available, you might test a circular snow sled or "Flying Saucer" to see if it will act as a substitute. These sleds are often designed as segments of a sphere. A shallow sphere segment will focus light or sound from a distant source to a point half the radius of the sphere. Aim the sled at the sun and see if it focuses the rays. It is at this point of focus that you place the microphone if you wish to record the amplified sound. The school shop class might design and execute the tripod and microphone's rubber mount.

Locating sound with earphones.

Microphone mount removed from rubber-lined receptacle.

An inverter kit of adequate wattage sells for $25. Perhaps the physics department would supervise assembly of the kit as well as furnish the laws of sound reflection and magnetic reproduction. It might be easier to procure the funds for an inverter if it is pointed out that the physical education department would have good use for a portable sound recording system.

To get recordings of the birds the students will find it necessary to know a great deal more about birds than they probably do. It is usually a revelation to find the variety that is available. An organized program should be outlined so that the different calls of each bird are recognized, possibly even interpreted.

Habitats should be correlated with species so that prediction of an area's inhabitants could be made with a measure of success.

Having made the recordings, select certain ones and assemble them on a tape. If some calls cannot be recorded in the field, they can be taped from commercial disks. This is permissible for education. The bird call should be *followed by* the identification, in order that the call be learned as a stimulus and the name as a response rather than the other way around. When the calls have been memorized, another tape can be assembled with the calls randomly placed and not identified. This can serve as a testing device or core around which certain participation games can be played. Group identification of songs played rapidly gets noisy but gets results.

From such a program many problems should arise whose solutions will lead to certain generalizations. It is hoped that students will discover some of these while working with such a device.

Solar furnace—test its efficiency
The function of color in reflectivity
Correlation of sound waves and light wave
Which sounds are received. (Longest wave reflected is four times the diameter of the reflector.)
Record football signals (????)
Lab experiments with a 35-mm projector and reflector
Correlation of the flying saucer and the mirror at Palomar
Make a Foucault's Pendulum and design a larger reflector
Compare properties of a circle segment and a parabola
You might even gather some nice bird calls

Program of the Committee on Education of the Society of American Bacteriologists

L. S. McCLUNG, *Chairman,*
*Committee on Education**

The Society of American Bacteriologists has long had an interest in the teaching of bacteriology. From time to time, and beginning as early as 1910, Presidential Addresses of the Society have called attention to the importance of including information relating to the microorganisms in the general biology courses at the secondary school level. Following the decision of the Council of the Society at the Chicago meeting in May, 1958, a Committee on Education was appointed, and included in the charge to the Committee was a directive to prepare teaching aids relating to bacteriology for distribution to teachers of introductory biology in high schools and colleges.

During the year six lists have been prepared. These are:

1. Reference Articles on Use of Bacteriology in Elementary Biology.
2. Papers of Microbiological Interest in Scientific American, 1951-58.
3. Introductory Bacteriology Films.
4. List of Supply Houses from which Bacteriology Supplies may be Obtained.
5. Suggestions for Experiments in Bacteriology in Introductory Biology Classes and Student Projects.
6. Selected List of Reference Books in Bacteriology.

All of the above lists are now available for distribution as is the Society's brochure "A Career in Bacteriology." Requests for these items, indicating those desired, should be addressed to the chairman of the Committee.

The Committee will develop additional lists on other topics and expand those which have been prepared in response to requests. Consideration also is being given to the development of a Handbook in Bacteriology for high school teachers. Comments concerning the desirability of this book and topics which should be included are solicited.

Teachers who wish information concerning membership in the Society should write to the Executive Secretary, 19875 Mack Avenue, Detroit 36, Michigan.

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Hybrid Vigor in Biophysics

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One of the basic understandings we have received from genetics is the theory that hybrid vigor is an important natural occurrence. It means, in the simplest sense, when two pure strains of related organisms are crossed the resulting hybrid is usually more vigorous than either of its parents. The advantages of hybridization are well known in corn, roses, and many domestic animals. Certain handicaps and disadvantages always accompany a hybrid, but these oftimes present minor problems in comparison to their overall values.

Evolution is brought about partly by the hybridization of organisms. In doing so, the hybrid will usually occupy one particular kind of niche. These niches require of the hybrid different and better adaptations than either parent can accomplish. It is said to be a *progressive* step in evolution if the hybrid can germinate, grow, reproduce, and become dispersed. The offspring must then do likewise.

Hybridization is not especially a unique characteristic of the biota alone. In all walks of life alliances and compromises are made when two or more fields of knowledge are employed to solve all sorts of problems.

Not too long ago chemistry and biology were almost completely separate disciplines of science. The principles, the tools, and the objectives of each were independent. Then someone saw a need for sanitation, for commercial fertilizers, antibiotics, blood typing, and other modern practices. An alliance between the problems in biology and the knowledge of chemists was formed on common grounds. Biochemistry, thus became the vigorous progeny. It has not only given mankind new insights into the characteristics of life itself, but it has also produced a very specialized kind of industrialization with widespread applications.

Thermonuclear devices and the era of rocketry and missiles have thrust upon biologists many new kinds of problems. In short, no one really knows what atomic radiation will do to the welfare of plants and animals in the long run of time. No one really knows yet whether men will eat and sleep successfully in the weightlessness of space travel. It is apparent that the physical scientists and their allies have produced something more complex than what biologists can solve by themselves. For a biologist to understand such problems and for biologists as a whole to bring their part of this new era up to par with the physical sciences, some understanding must be reached about the characteristics of these new accomplishments. This automatically puts biologists one step behind and calls for hybridization of knowledge.

Radiant energy from the sun is essential for life. Radiation from the atom is generally detrimental to protoplasm. In general, exact dosages from X rays and atomic radiation are still extremely complex problems involving many unknown characteristics. In both instances the physical principles of *energy* are involved and this automatically allies biology with physics.

Not only is biology allied with physics in the fields of radiation and aerobiology, but similar combinations with other fields are noteworthy. It is understood now that bats navigate by means of a radar-type of facility. Experiments have demonstrated that changing the frequency of timing of sound waves can alter the breeding habits of certain animals. Plants respond to gravity and centrifugal forces while growing. The roles of electricity and magnetism on biological behaviors are essentially unexplored. The fields of extrasensory perception, mental telepathy, and other types of communications in animals, all provide interesting avenues into the physical nature of biological behavior. There is evidence that migrations of birds, salmon, etc., to some extent rely on physical phenomena which must be accurately defined. The opportunities in biophysics are just beginning and have unlimited challenges.

There is a variety of science projects which may be carried out in the biology laboratory to encourage hybridization of interests between biology and other sciences. Projects in biophysics usually attract considerable attention at science fairs. Some of the projects suggested below may be more stimulating to the student who is most adept with the electrodes, or levers, than with the microscope or a scalpel and "pickled" frog. Growth and behavioral responses of plants and animals to colored

lights, to an electrical field, to treatment with X rays, to heat, etc., are simple to carry out and provide interesting results. The analysis of mechanical leverages in biological systems, for example, skeletons, takes a twist into arithmetic and simple mathematics. Calorie counting and the energy flow in the food diet of grasshoppers would be much more challenging than the average biology student could handle, but the gifted student could penetrate a problem of this sort as deeply as his talents would permit. Problems dealing with the uptake of radioisotopes by different organisms in an aquarium are facilitated now by the availability of detecting equipment from the AEC sponsored programs and by the ease of obtaining small quantities of radioisotopes from commercial producers without the need of licensing.

Biophysics is usually offered only to advanced students, namely, the upper-class and graduate students in colleges and universities. Nevertheless, there is a sufficient amount of simplicity connected with many aspects of this field so that rather simple problems can be pursued by almost any interested student in high school biology.

The biology laboratories in the secondary schools are the prime places where embryonic "scientists" are conceived. The scientific interests begun here can either grow or die. Fields of *professional* endeavor oftimes have beginnings here. At least the potential scientist in these laboratories has the opportunity of rejecting a career in biology or of looking forward perhaps with a favorable attitude to other studies in science. Somewhere along the line the physical sciences seem to gain more scientists than the biological. This is evident if one compares the enrollment of the graduate students in each of these divisions in many of our major universities. This seems somewhat strange when one realizes that students usually begin their science studies with biology. Is not biology in a better starting position to gain and to hold potential biologists?

Hybridization between biology and chemistry, physics, geography, mathematics, and the languages is not anticipated to be of major value in secondary education. There are strong reasons to believe that such a practice "waters down," "breeds a lack of fundamental disciplines," "accomplishes nothing," or even, "is unreasonable because it is already difficult to get students to understand biology as it is." Perhaps breadth is no substitute for depth, but it seems as if hybridization is worth while if it widens interests, particularly, if it will fill niches which must eventually play a part in the solution of the galaxies of problems in physical biology.

The employment opportunities for those who can successfully combine biology with physics are increasing daily. Opportunities are found in health physics, aeromedicine, and many others. For the professionalist, the challenges are unlimited and the rewards are high; for the college graduate the opportunities as technicians are very good.

Hybridization is a very natural function, and it appears to be a very necessary element for survival in all walks of life. It can be employed more widely for reaching the scientific objectives of modern times.

Books for Biologists

BIOLOGY—THE SCIENCE OF LIFE, Addison E. Lee, 270 pp., $2.00, The Steck Company Publishers, Austin, Texas, 1958.

Although this publication seems to have the form of a workbook, it is more than that. Introductory material for each unit makes this a semi-text. The traditional workbook format, together with suggested experiments and annotated bibliography, indicate that it should be a valuable self-teaching aid. Tests accompany the publication. There is use also made of reading material which becomes the subject for interpretative questions following.

HANDBOOK OF TOXICOLOGY, VOLUME IV, TRANQUILIZERS, Maxwell Gordon and R. F. J. McCandless, 120 pp., $4.00, The National Academy of Sciences, The National Research Council, W. B. Saunders Company, Philadelphia, 1959.

The volume collects information about all useful tranquilizing drugs in a fashion which cannot fail to be helpful. Compounds are treated alphabetically by trivial name but the index lists also the chemical designations and trademarks. For each compound are provided chemical formula, molecular weight, structure and physical properties as well as brief summaries under the headings: Pharmacology, Clinical, Toxicity, Mode of Action, Metabolism, and Antidote. All statements are adequately documented with references as recent as 1958. The biologist might wish that those few substances known to occur naturally had been identified with their sources.

C. W. Hagen, Jr., Indiana University

The 1959 Purchase Guide

PURCHASE GUIDE FOR PROGRAMS IN SCIENCE, MATHEMATICS, MODERN FOREIGN LANGUAGES, Council of Chief State School Officers, 336 pp., $3.95, Ginn and Company, Boston, 1959.

This is no ordinary book review. It is an announcement of an important book which should be and will probably be found in every school in the country. The Purchase Guide is a coded volume listing equipment recommended for science courses in the elementary and secondary schools.

Begun on the initiative of the Council of Chief State School Officers, the project had the enthusiastic support of the U. S. Office of Education, National Bureau of Standards, Educational Facilities Laboratories, Scientific Apparatus Makers Association, and several science organizations. It was designed to assist schools ready to purchase equipment under the terms of the National Defense Education Act, Title III. Biology was represented by Paul Klinge, upon nomination of the American Institute of Biological Sciences.

When it was realized that the states participating under the NDEA have a wide variety of plans for the purchase of science equipment, the difficulty of the task becomes apparent. Equipment has been listed alphabetically but with numbered designations. Each item is coded to indicate the quantity of the item recommended for each type of science course. A short paragraph will aid the user and administrative officer doing the purchasing as it describes the use of the item. Specifications then follow. A summary list of the items by subject matter is also included. Several essays explaining some of the important phases of each science as well as a bibliography of approximately fifty recommended books for each of the subject areas are included.

This is in no sense a definitive work to settle for all times the problem of laboratory equipment. There was a rush tag on the project. Annual revisions are contemplated. But every biology teacher will find this useful to measure his own laboratory inventory with this recommended list, to aid him in purchasing new equipment, and to show to the cautious administrator ready to purchase under the NDEA what has been recommended for a first class science laboratory. Discriminating readers will look for omitted items which were probably left out for several reasons, because there is every evidence that they were carefully considered for inclusion. Thus the editing job on the list is of significance. The fact that the Scientific Apparatus Makers Association sponsored the work indicates that the volume cannot be interpreted as governmental dictation in any way but simply for what it was intended: a useful guide for the purchase of laboratory equipment for the improvement of science teaching.

HISTORY OF BIOLOGY, F. S. Bodenheimer, 465 pp., £2. 2. 0., William Dawson & Sons, Ltd., London, 1958.

An encyclopedic source book of the history of biology. The organization of the book is different than the orthodox science histories. The first section consists of general information, philosophical background, and miscellaneous thoughts. It should be indicated that this is written in a narrative fashion which is quite interesting to read. The second section is a capsule history of biology. The final part lists prominent biologists, beginning with the ancient Egyptians and going on to Morgan, and gives substantial excerpts from their published work. Teachers will find all three sections valuable, but the final part will be especially valuable for precise quotations and original source material.

COMPARATIVE MORPHOLOGY OF VASCULAR PLANTS, Adriance S. Foster and Ernest M. Gifford, Jr., 555 pp., $9.00, W. H. Freeman and Company, San Francisco, 1959.

A technical college text which will prove to be a handy reference for the high school biology library. Thoroughly documented and illustrated, there is a phylogenetic approach to the subject of plant morphology. Teachers will appreciate the fine diagrams, especially those of alternation of generations. Special problems in morphology give clues as to project possibilities. Fossil plants are also included to make the systematic treatment more complete.

FELLOWSHIPS IN THE ARTS AND SCIENCES 1959-60, Virginia Bosch Potter, 195 pp., $3.75, Association of American Colleges, University of Wisconsin, Madison, 6, Wisconsin, 1958.

A useful compilation of fellowships available for foreign and American study, both on the predoctoral, postdoctoral, and senior level. Nicely cross-referenced. Volume is concise yet inclusive. Helpful hints to prospective applicants are given.

EDUCATION AND FREEDOM, H. G. Rickover, 256 pp., $3.50, E. P. Dutton & Company, New York, 1959.

Another blast from a real demolition expert. This is a collection of essays and speeches by the Admiral on education. Whatever the opinion about these opinions, one must admire the clear and biting prose. One interesting chapter on "The Meaning of a Profession" makes statements which the rest of the book seems to forget in its attack on professional "educationists." However, there remains enough bitter truth that

the Admiral cannot be ignored. Certainly his statements on the importance of subject matter background and education in general are ones with which few of us can disagree.

ANIMAL CAMOUFLAGE, Adolph Portmann, 111 pp., $4.50, University of Michigan Press, Ann Arbor, 1959.

Translated from the German, this is an interesting little book which is part of a new series being developed by the University of Michigan Press. Camouflage is discussed from a general standpoint, shape, coloring, and significance. The illustrations help make this a valuable book for all teachers and students of biology. Easy reading for students.

MAN'S WORLD OF SOUND, John R. Pierce and Edward E. David, Jr., 287 pp., $5.00, Doubleday & Company, Inc., New York, 1958.

To those interested in the production of sound, whether biological or by machine, and the reception of sound, this is an indispensable book. The biology teacher will find in it all kinds of ideas for projects involved in the physiology of speech and hearing. The hi-fi fan will learn many things he never knew about his hobby. The speech therapist will be able to obtain a background of the latest research in his field. In short, this book has many valuable uses for those interested in the physics and physiology of sound. It is written in an interesting personal way by two Bell Telephone engineers. Well illustrated, the reviewer found that with its text it will become an important part of his biology teaching.

ELEMENTS OF THE UNIVERSE, Glenn T. Seaborg and Evans G. Valens, 253 pp., $3.95, E. P. Dutton & Company, Inc., New York, 1958.

Written from the outstanding television films produced by the author. The level seems aimed at junior and senior high school audiences. The treatment is a review of some classical chemistry with modern chemistry woven around the periodic table and the Seaborg revised version. The publisher seems to have had several lapses in makeup as statements by famous scientists about discoveries of new elements are woven into the text with very little delineation of the treatments. The illustrations are excellent except for some rather meaningless photographs of some of the elements. On the whole, this will prove to be a very valuable book in furnishing an introduction to modern chemistry by a Nobel Laureate for beginning science students. Highly recommended for biology classroom libraries to supply the latest information on the elements, especially those numbered 98 and above.

DEVELOPMENT AND STRUCTURE OF THE FROG, A PHOTOGRAPHIC STUDY, Addison E. Lee, Earl R. Savage, W. L. Evans, 44 pp., $1.00, Rinehart & Company, Inc., New York, 1959.

A book which should be found in every high school biology laboratory. The photographs sometimes lose clarity in printing, and color would have been of immense value. Useful in dissection and embryological studies of the frog, it also includes full instructions for several experiments and projects. Probably would be useful in each student's hands as he proceeds in his dissection.

TEACHING SCIENCE, Walter A. Thurber and Alfred T. Collette, 640 pp., $6.75, Allyn and Bacon, Inc., Boston, 1959.

This book discusses the problems and techniques of successful science teaching in today's secondary schools. It considers such topics as the pupils we teach, science programs in schools, field trips, laboratories, audio-visual aids, tests, science clubs and many others.

THE CHALLENGE OF SCIENCE EDUCATION, edited by Joseph S. Roucek, 491 pp., $10.00, Philosophical Library, New York, 1959.

More than thirty collaborators discuss various cross currents of thinking on all major educational practices in the fields of science in America and abroad. This book is designed for the general reader as well as the specialist. It considers the formal aspects of education from the pre-primary through the high school, college, and university levels.

THE MAMMALS OF NORTH AMERICA (Two Volumes), E. Raymond Hall and Keith R. Kelson, 1,193 pp., $35.00, The Ronald Press Company, New York, 1958.

This monumental two volume work of 1,193 pages gives a systematic account of all the mammals occuring in North America including Central America and the West Indies. Each species and subspecies of mammal is carefully described and its distribution mapped. Keys are included, as well as numerous line drawings. There is a long chapter devoted to the zoogeography of the mammals. This is a descriptive work that will have to be consulted by every student of mammals.

THE PLANT KINGDOM, (Laboratory Manual), Paul C. Lemon and Norman H. Russell, 176 pp., $3.25, C. V. Mosby Company, St. Louis, 1959.

A laboratory manual covering the field of general botany. There are outline drawings to be labeled.

BIOLOGY, third edition, Claude A. Villee, 615 pp., $6.75, W. B. Saunders Co., Philadelphia, Pennsylvania, 1957.

This introductory text attempts to present the

major facts and principles of modern biology without superficiality and yet without undue emphasis on detail. This third edition contains major revisions in the chapters on genetics, evolution, and human anatomy and physiology.

LABORATORY DIRECTIONS IN GENERAL ZOOLOGY, Mary J. Guthrie and John M. Anderson, 233 pp., $3.50, John Wiley and Sons, Inc., New York, 1958.

These directions begin with the frog as the introductory type, although slight modifications are necessary to adapt them to courses in which the amoeba and exercises in microscopy are studied at the beginning and the frog at the end of the term's work. Selection by the instructors, with the omission of certain sections, should make these directions satisfactory for one-semester courses. The three divisions are: the frog, heredity and variation, and representative invertebrates.

REASON AND CHANCE IN SCIENTIFIC DISCOVERY, R.Taton, 171 pp., $10.00, Philosophical Library, New York, 1957.

This work examines the relative roles of active purpose and chance in the processes of scientific discovery and has a penetrating insight into the workings of the inventive mind. The author illustrates his thesis by numerous practical examples drawn from the lives and works of such distinguished scientists as Claude Bernard, Galileo, Roentgen, Becquerel, the Curies, Liebnitz, Newton, et al.

BIOCHEMICAL INDIVIDUALITY, Roger J. Williams, 214 pp., $5.75, John Wiley and Sons, Inc., New York, 1956.

This is the first work to collect the available information on inter-individual variability such as specific enzyme levels, endocrine activities, and nutritional needs in which five-to-ten-fold variations between normal individuals appear to be very common. As well as defining the present state of knowledge of biochemical and physiological individuality, this book points to areas where more research is needed.

BRITISH MAMMALS, Maurice Burton, 64 pp., $2.75, Oxford University Press, New York 16, 1958.

Illustrated, small book meant for children interested in reading about mammals. Language is of high level for most elementary pupils, but information and drawings are fascinating. Most mammals discussed are common in the U. S.

PRINCIPLES OF IMMUNOLOGY, John E. Cushing and Dan H. Campbell, 344 pp., $6.50, McGraw-Hill Book Company, Inc. New York, 1957.

This book is designed primarily for college seniors and graduate students majoring in biology. The first part of the book reviews aspects of the physical sciences important for an understanding of subsequent discussion of antigens and antibodies and also presents a broad general survey of immunology; the second part deals with biological problems in which immunological reactions and concepts play an important role both as an intimate part of the biological processes described and in the understanding of these processes.

DAIRY MICROBIOLOGY, Edwin M. Foster, F. Eugene Nelson, Marvin L. Speck, Raymond N. Doetsch, and Joseph C. Olson, Jr., 492 pp., $4.25, Prentice-Hall, Inc., New York, 1957.

Prepared as an interpretive source of information for those in the dairy industry, this book is concerned with the microbiology of milk and dairy products. Factors influencing growth and death of microorganisms are discussed in detail as are sources of contamination and the applications of microbiology to specific dairy products.

DEVELOPMENTAL CYTOLOGY, edited by Dorothea Rudnick, 215 pp., $7.00, The Ronald Press Company, New York, 1959.

This is the sixteenth symposium of the Society for the Study of Development and Growth. It includes discussions of protozoan cells, chromosomal changes in plant and animal cells, genetic changes in tumors, changes in chloroplasts, and many other topics.

THE LIFE AND LETTERS OF CHARLES DARWIN (2 volumes), edited by Francis Darwin, 1,210 pp., $10.00/set, Basic Books, Inc., New York, 1958.

A reprint of the Autobiography of Charles Darwin and his important letters. Many of these letters include correspondence with important scientists and help explain the development of his theories.

TABOO, Franz Steiner, 154 pp., $4.75, Philosophical Library, New York, 1956.

Dr. Steiner makes clear that none of the theories of taboo customs has more than a limited validity. One chapter discusses taboo as a Victorian invention; a second the very interesting and complicated taboos described in the Pentateuch. This is a far cry from Polynesia, the traditional home of taboo. But where values are different there will be different sorts of "danger behavior," perhaps the most satisfactory, though still tentative, definition of taboo.

INTRODUCTION TO HUMAN ANATOMY, Carl C. Francis, 548 pp., $5.75, C. V. Mosby Co., St. Louis, 1959.

A very complete and attractive book which is well written and easily read. There are excellent text illustrations (324) and twenty-nine color plates.

PLANT PROPAGATION, PRINCIPLES AND PRACTICES, Hudson T. Hartmann and Dale E. Kester, 559 pp., $8.75, Prentice-Hall, Inc., New York 11, 1959.

Here in one volume is a lucidly explained and encyclopedic coverage of the theoretical aspects and practical techniques for the propagation of higher plant life. In the last part of the book are presentations of nearly 50 of the world's important fruit and nut crops plus 100 of the major woody ornamentals.

PHYSIOLOGY OF MUSCULAR ACTIVITY, Peter V. Karpovich, 368 pp., W. B. Saunders Co., Philadelphia, 1959.

An excellent muscular physiology text for physical education work with a list of questions at the end of each chapter which might serve as a guide for studying and for quizzing.

THE ROBINSON FROM MARS PAPERS, Edward Le Roy More, 128 pp., $3.50, Exposition Press, Inc., New York 16, 1956.

A book for thinking people, it contains rare bits of comedy and wit in its cerebral pages. The debaters include, among others, a Catholic priest, a suicidal American Indian artist, a Methodist minister and his Christian Socialist wife, a lady tippler, a gifted child and a young beauty reared by a Jain—an articulate and interesting group. The present volume, composed of two books—*How Judge Truth* and *you, the Pou Sto,* the Focus of Being—is the first of four proposed volumes which will comprise *The Robinson from Mars Papers.*

Robinson is a young man of unknown origins who is rescued from the sea as a baby of the Sage, a philosopher, and raised on the otherwise uninhabited South Pacific island of Mars.

INSIGHT, Bernard J. F. Lonergan, 785 pp., $10.00, Philosophical Library, New York, 1957.

This book is the conclusions of a philosopher who accepts the findings of modern schools of thought and is prepared to attempt the task of presenting a view of human life and knowledge as a whole. This is a fresh and vigorous restatement in modern terms of a large area of scholastic metaphysics ethics and psychology.

GROUP PSYCHOANALYSIS, B. Bohdan Wassell, 306 pp., $3.75, Philosophical Library, New York, 1959.

The author's underlying thesis is that group analysis evolved out of historical as well as economic necessity, as the esoteric method of individual analysis became ready for democratization. He constantly focuses on how phychoanalytic theory can be applied to best advantage in both group and individual settings. Technical aspects of the therapeutic process are clinically documented and fully explored within the framework of group analytic relationships. He writes for fellow psychiatrists and psychoanalysts, for the psychotherapist and counselor, and also for those in education and industry who are concerned with group dynamics and individual performance.

CORTISONE THERAPY, J. H. Glyn, 162 pp., $10.00, Philosophical Library, New York, 1957.

The author deals fully with the place of cortisone in the management of such collagen disorders as systemic lupus erythematosus, polyarteritis, nodosa, and dermatomyositis, and of allergic states.

THE NEW CHEMOTHERAPY IN MENTAL ILLNESS, edited by H. L. Gordon, 762 pp., $12.00, Philosophical Library, New York, 1958.

The present decade of this century will be remembered for the introduction of the "tranquilizing," or ataractic drugs in the treatment of mental illness. This work, by one hundred and sixty-seven medical experts, reviews their multiple experiences with these drugs in treating such psychiatric disorders as schizophrenia, manic-depression, neuroses, mental retardation, senility, etc.

DISCOVERING THE REAL SELF, E. F. McDaniel, 117 pp., $3.75, Philosophical Library, New York, 1958.

This volume, written for the layman, sets forth the scientific concept of the human being and describes these specific attributes which enable man to function in harmony with his environment. When this functioning is distorted and twisted, when it is in conflict with our fundamental needs and desires, strains and stresses are created within the organism. Only a true understanding of the essence of man will enable us to behave efficiently and contentedly.

FOOD AND YOU, Edmund Sigurd Nasset, 166 pp., $1.25, Barnes and Noble, Inc., New York, 1958.

An up-to-date book containing information about nutrition such as: balanced diet, digestion, protein, fat, carbohydrate, vitamins and minerals. The 46 pages of tables include food composition tables, recommended daily allowances, and a sample low calorie diet.

THE FOUNDATIONS OF LIFE SCIENCE, Mark Graubard, 627 pp., $6.50, D. Van Nostrand Co., Inc., Princeton, New Jersey, 1958.

In developing an orientation course for students who do not major in science, this book focuses on the basic concepts which encompass all of biology, making unnecessary the usual division of biology into zoology and botany.

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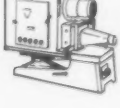

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